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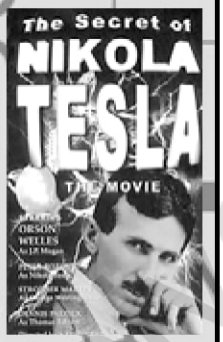

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Infinite Energy
Cold Fusion and New Energy Technology

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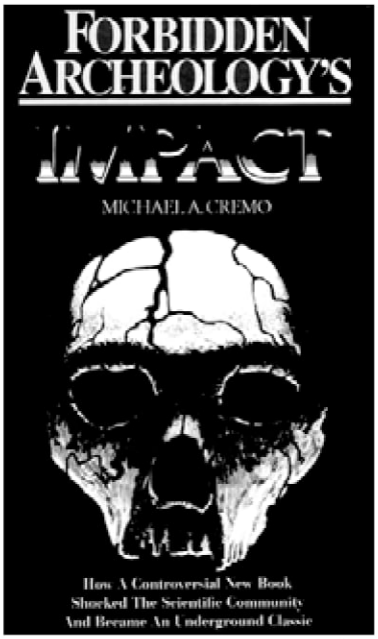

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This review is not so much about the subject matter of three closely related books, but rather about the nature of evidence and its treatment when a favored paradigm is challenged.
—*Mike Carrell*

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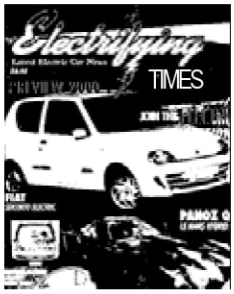

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Breaking Through

The Bright Shining Hope

by Eugene F. Mallove, Sc.D.

The Sun shines on the deep blue ocean—a sea of stupendous, potential energy for humanity. We now know that the nuclear-scale energy locked within the hydrogen in the billion cubic kilometers or more of water on this planet is too large to imagine. The peer-reviewed and non-peer-reviewed scientific literature in this field proves that. For all practical purposes for humanity, this new energy from water is infinite. We should seize the day and develop this energy, but we are not doing so, at least not at a speed most of our readers desire.

It is November 1999, only a few weeks to the millennium date change. Only a few primitive primates on a strife-torn, noisy planet, banded together now with a magazine, journals, newsletters, Internet, and World Wide Web are listening to this message. Shall we call this species *Homo Absurdus*? Perhaps. Mother Nature offers us valuable gifts and we reject them.

What the acceptance and development of the infinite energy resource in water—"cold fusion," Low-Energy Nuclear Reactions, or hydrocatalytic hydrogen power of BlackLight Power Corporation—would mean to the world transcends our ordinary means of describing things. The scenarios that would unfold following the Great Turn-Around of acceptance are apparently just not believable to the bulk of humanity. The hope is just "too good to be true" and, besides, they are told by Establishment scientists and press that cold fusion is being purveyed by shysters and crackpots—us. We find ourselves in an outcast, outlaw field in the house of science, in the house of politics, in the general and scientific media, and in the realm of financial and environmental discussions. For all practical purposes, this field does not exist. Correction: It exists to be beaten up for sport by professional know-it-all hacks, such as Dr. Robert Park of the American Physical Society (see p. 30).

There is hope, however, to turn all this around, perhaps a bright shining hope. As I stated in my last editorial, no utilitarian, scaled-up cold fusion heaters or electric generators have been marketed. This is the Achilles heel of cold fusion science, used against us interminably by the critics.

Unfortunately there are also no "miracles"—spectacular breakthroughs—to report this time that will change this any time soon. Contrary to my editorial in Issue No. 27, "'Miracles' Happen," the Boscoli "warm fusion" process for which we had held such high hopes has shattered right before our very eyes. Please read the report in this issue of my visit to Italy (p. 10). I planned to examine and witness experiments to substantiate this patent-applied-for, high-temperature process. Instead, this visit degenerated quickly into a tragic farce, as the CEO of Paradigm Energy Corporation, David Cappelletti, was unable or unwilling to pry any convincing data out of the recalcitrant and evidently paranoid Renzo Boscoli.

Boscoli has now decided to go in another direction: the production of copious energetic neutrons, which he believes he can turn directly into electricity. Frankly, this looks to us like a lame excuse not to come clean on what he has or has not achieved. This is one of the most unfortunate episodes that I have ever encountered in the long, weary years of the Cold Fusion War. As we have said many times to ourselves here at *Infinite Energy*, "With 'friends' like these, we don't need enemies."

I wish to apologize to our many loyal readers for having raised their hopes unnecessarily, only to have to bring them down with this depressing disintegration of the Boscoli claims. If this man, Renzo Boscoli, has ever proved to himself that he has nuclear-scale excess energy in his systems, let him step forward and publish his data the way other cold fusion scientists have done this past decade. Our pages are open to him, but we do not expect he will allow anything of substance to be published.

A man who encodes his data in lab notebooks and hides that data from the man—David Cappelletti—who has supported him with hundreds of thousand of dollars is not to be trusted. That is obvious. It is also outrageous and unethical that Cappelletti did not tell this Editor about the state of affairs before we went to press with Issue No. 27. In fact, he baited us then and before my recent trip to visit the lab in Italy with promises that the great Renzo Boscoli would soon be coming out with more papers for this magazine to publish. Boscoli is also a hypocrite. He claims to be supportive of the cold fusion field, yet he will not supply any evidence of experimental success. As I left him in Italy, he smiled and said that I was "like a lion" defending the cold fusion field. Subsequently I learned from Cappelletti that Boscoli was extremely upset with me for having used a tape measure to determine the length of his warm fusion apparatus. I was told by the Cappelletti crowd that I "was not sensitive to the ways of Italian scientists." Baloney! No such behavior would have occurred in the laboratory of any of the Italian scientists I know.

So, what is the "bright shining hope" amidst this gloom? People! There is a tenacity among the individuals in the cold fusion research community that will not let this fall into oblivion. The power is in the people of cold fusion/new energy to bring power to the people. Lives, treasures, and health have been lost by many who have been pursuing this revolutionary science since 1989 and before. Still, the pool of intellectual power

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grows steadily and new scientific and industry converts are made every day. We need a catalyzing demonstration—a concrete embodiment of excess energy—that will ignite the Great Turn-Around.

When such a table-top demonstration device is in wide circulation among high schools, colleges, and industry, the opposition to this field will collapse into a large pile of ash. Yes, the small water-fueled excess heat cell will be the weapon that ends the Cold Fusion War. An entrepreneurial revolution will follow that will make the personal computer and Internet revolutions look tame. It will be the beginning of the end for the business-as-usual corrupt Scientific Establishment that has sucked the life-blood of hope out of humanity on this issue for the past decade.

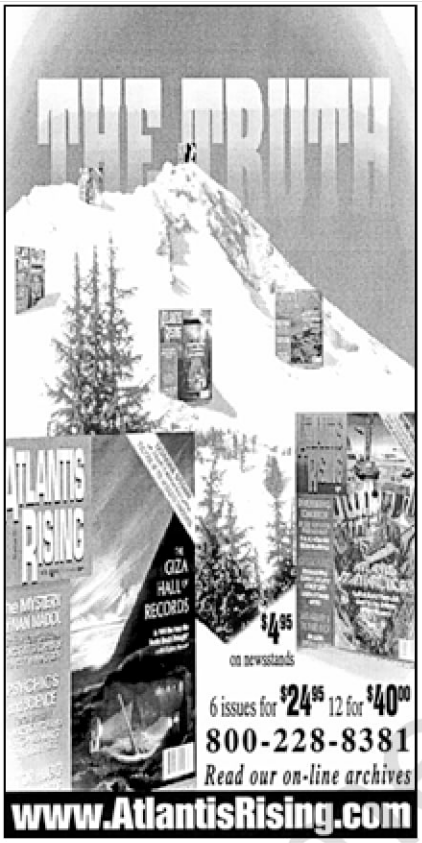
Some of professorial stature in the cold fusion field don't like to think in these terms. They don't like these kinds of editorials, or so I have heard. Many of them would prefer to live in peaceful coexistence with that Establishment in which they grew up. That is a dream. It will not happen. The cold fusion revolution will either end with a bang or it will die with a whimper. Gradualism—the endless compounding of scientific paper after scientific paper in this field (necessary as those papers are!) we predict, will fail utterly. We wish the world did not work that way, but it does. That is one instance in which we'd like to be proved wrong.

We will meet again in 2000, a time of transition for cold fusion and new energy.

∞

Scientists must continually be motivated by the "mother" of all questions: what facets of nature remain undiscovered because what we consider to be theoretical certainties prevent the posing of new challenging questions?

—Beverly Rubik



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LETTERS TO THE EDITOR

Cold Fusion Next Major Technological Advance

I was present when Dr. Mallove spoke in Fiji in January 1999, and I was very impressed by what he said, regardless of how other people disbelieve that cold fusion will ever be commercially achievable, or that it will ever work at all.

To me, it will be the next major advance in technology, and even allow some of the space-faring vessels we only see in science fiction. Pollution will be a story unbelieved by children who have never seen it and small aircraft similar to microlights will be able to fly from one side of Australia or America without stopping.

Although I am not exactly sure how the cold fusion reaction works, the future is certainly going to be an exciting place to live, perhaps the last undiscovered country.

Morgan Cummins
Australia

✍ ✍ ✍

Mallove Speaks to GE Group

Dr. Mallove spoke before a group of over 110 retired General Electric employees in Peabody, Massachusetts on July 13, 1999:

Thank you for your most interesting talk on the subject of cold fusion. The response of the group during the question and answer phase, and afterward, certainly indicated their appreciation. I have played the videotape, "Cold Fusion: Fire from Water," and intend to make it available to my contacts.

The attendee who presented Dr. Myrle Cohen as his science advisor was Hughes Ogilvie, retired Manager of Marketing, Medium Steam Turbine, Generator and Gear Department. That Department was a $100 million business in 1951. Myrle Cohen holds a Ph.D. in chemistry and was Manager of the Department's Chemistry Laboratory. The General Electric Company is very serious about continuous education and training. For example, I was a member of their Marketing Training Program and presented the Instrument Department's program at other GE facilities. Later, I spent thirteen months with the Apparatus Sales Division as an Instrument Specialist prior to changing career goals and pursuing Engineering as a discipline. I retired with the title of Principal Engineer.

Myrle Cohen summed it up neatly with his statement that, "The truth will be known." We wish you and your fellow cold fusion developers good luck in your endeavors.

Robert J. Willis, Jr.
Ipswich, Massachusetts

✍ ✍ ✍

Keep Laws of Physics in Mind

Let me suggest a possible explanation of the remarkable experiments of Miley and Patterson (*IE* No. 9) and Ohmori and Mizuno (*IE* No. 27). A moderately energetic electron colliding with a proton, followed by the pair striking a second proton, can generate a deuteron and a neutrino sharing 1.44 MeV kinetic energy.

$$2p + e \rightarrow d + v + 1.44 \text{ MeV}$$

A 1.4 MeV deuteron can generate nuclear transmutations in electrode material. In contrast to the suggestion of Ohmori and Mizuno, an electron and a proton cannot generate a neutron and a neutrino in the absence of 0.78 MeV input energy. (Both reactions require a neutrino to conserve lepton number.)

A researcher in cold fusion does himself and his colleagues no favor by suggesting explanations which violate the laws of physics. In contrast, a plausible explanation consistent with the laws of physics may help persuade open-minded individuals such as David Goodstein of Caltech. Properly treated, theory can play a definite role in convincing the scientific community of the viability of cold fusion. Of course, nothing can persuade individuals such as Park and Huizenga.

Robert Parmenter
Tucson, Arizona

✍ ✍ ✍

Klassic Response

Reference Editor-in-Chief Mallove's response to my letter to the editor (in Issue No. 26), correcting his factual error in his earlier article about my approach during the past thirty-three years in investigating famous UFO cases. Mallove now admits that he is "not an expert on UFO case investigations," so he turns for support to a man "whose work in the UFO investigation field I (Mallove) do respect, Dr. Bruce Maccabee."

Mallove fails to inform readers that Maccabee has endorsed the authenticity of ALL of the many "hokie-looking" UFO photos taken by Ed Walters of Gulf Breeze, Florida. After a small model resembling the UFO in Walters' photos was discovered hidden in the attic of his former house by its new owners, most pro-UFO researchers concluded that the photos were hoaxes—but not Maccabee. Maccabee was paid $20,000 to write a single chapter endorsing Walters' UFO photos for his book. Later, Maccabee and Walters co-authored a book claiming proof of ET visitations based in part on Walters' UFO photos.

Philip J. Klass
Washington, D.C.

Bruce Maccabee Responds

In his response to Gene Mallove, Philip J. Klass asserts that "most pro-UFO researchers concluded that Ed Walters' photos were hoaxes" after a model was found at Ed's old house. (Investigation showed that the model itself was likely to be a hoax created to discredit Ed.) I personally know many, many investigators who consider the photos and sightings to be real. This includes many residents of Gulf Breeze who would be likely to know if there was hoaxing involved. Some of the residents had their own similar sightings. Hence, without a poll of investigators, Klass cannot simply assert that most consider it a hoax. In any case, my conclusions regarding the sightings and photos by Ed Walters and numerous other citizens of, and visitors to, Gulf Breeze were arrived at after an intense and thorough investigation of all aspects of the sightings, including analysis of verbal testimony and analysis of stereo photos, among others.

Klass says that I was paid to write a single chapter endorsing Walters' UFO photos for his (first) book. This leaves the reader with the impression that my endorsement may have been contingent upon receipt of payment for the chapter. It was not. Klass has not informed the reader that my conclusions were publicly stated, after several months of investigation and analysis, but many months before there was a book contract. As is usual for UFO investigation, I received no compensation (but spent a lot of my own time and money) for the research and writing which were published by the Mutual UFO Network and the Fund for UFO Research in July, 1988. The book contract, on the other hand, was signed months later, in November, 1988. It required that I write a chapter outlining my investigation and results. The book was *The Gulf Breeze Sightings* by Ed and Frances Walters (Morrow Pub., 1990).

Klass also refers to a book co-authored

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by me and Ed Walters, *UFO's Are Real: Here's the Proof* (Avon, 1997). The justification for accepting the sightings of Ed Walters and many others are presented in that book. I invite interested persons to read that book and learn about the types of analysis that have been done.

Klass has neglected to inform the reader that there are numerous other sightings which I have investigated for which there is nearly or completely unanimous agreement regarding their authenticity.

Bruce Maccabee
Sabillasville, Maryland

✍ ✍ ✍

Problems with Case Cell?

In the Device and Process Testing Updates section of Issue No. 25 (p. 27) of *Infinite Energy*, you mention that you have had trouble duplicating Les Case's results along with EarthTech. In the original article you ran on catalytic fusion entitled Progress in Catalytic Fusion, Les was quoted as saying that there are some tricks to getting his cells to run properly.

SRI International had trouble too—until Les counseled them. I would hazard a guess that those cells that run properly are run under Les's guidance while the others are not. Anyone who wants to do research and development in the area of catalytic fusion will have to hire Les!

Dennis P. Allen, Jr.
Spring Lake, Michigan

✍ ✍ ✍

Praise for Issue No. 26

I must congratulate you on the interesting feature you published about dear old Charles P. Steinmetz (*IE* No. 26, p. 20). It is very gratifying to read these features on past pioneers. I decided to search my library for a copy from my I.E.E.E. files for a unique feature article published during the 1960s about Steinmetz. Having found it, I now dispatch you a copy of it along with the extracts. It was published in I.E.E.E. Spectrum in April 1965 and I am sure you will enjoy reading it. Steinmetz was not only a brilliant scientist, he was a great teacher and experienced great joy from his various pranks performed from his summer solitude camp alongside the Mohawk River. I feel it could make a fabulous feature for your magazine.

Reference Extreme Physics (page 9), the quote by Dr. Thomas E. Phipps, Jr.: "Taxpayers are conditioned to think of 'research' as what is done in universities by people with government grants. Actually, research is what was done by the Wright brothers with their own money." My sentiments exactly! I couldn't have put it better myself; it should be framed and displayed in every new energy scientist's office, as I intend to do.

Robert G. Adams
New Zealand

[*Editor's Note:* Thank you for your 1960 article on Steinmetz. We encourage readers to submit relevant historical articles for possible future publication.—*BDR*]

✍ ✍ ✍

ZPE Originated with Planck

Good coverage of ZPE (Valone, *IE* No. 26, pg. 53). Nevertheless, a point clearly neglected in the article and not fully appreciated by most individuals (including physicists) is that zero-point energy originated with Max Planck in 1912. In determining the probabilites of emission of radiation in discrete quanta from an atomic oscillator (atoms), Planck combined thermodynamic considerations from entropy equations and blackbody radiation to arrive at an equation for the average energy, U, of an atomic radiatior as:

$$U = \frac{h\nu}{e^{h\nu/kT}-1} + \tfrac{1}{2}h\nu$$

where ν = oscillator frequency.

It can readily be seen from this equation that even if the temperature, T, goes to zero (the first term→ 0), there is still a residual energy in the amount of 1/2 the quantum, hν. Einstein was aware of Planck's work and even used these concepts in some of his derivations of blackbody radiation (1913).

Another interesting point is that in 1924 R.S. Mulliken (a prominent chemical physicist) discovered direct evidence of zero-point energy *experimentally* in the vibrational spectra of diatomic molecules even before Heisenberg (and Dirac) derived quantum mechanics formalism (1925-26).

In 1926-30, Heisenberg and Dirac's Quantum Electrodynamics (QED) provided for the existence of a fluctuating zero-point electromagnetic or vacuum field in the absence of any sources. The field mode could be described as a harmonic oscillator (just as in the Planckian oscillator) with a similar result that the mode energy, $E_n=(n + 1/2)\ h\omega$, where n describes the number of energy quanta (or photons) and ω is the frequency of the field mode; so that even with zero photons there is a vacuum field energy of 1/2 hω.

An excellent mathematical treatise on these and other aspects of zero-point vacuum phenomena can be found in Peter Milonni's book, *The Quantum Vacuum* (1994).

I would like to extend applause for the excellent research article by Don Reed on torsion fields, which we believe represents the next major step in the discovery of the fundamental structure of the vacuum.

Gary Gilmore
U.S. Research & Development, LLC
Metairie, Louisiana

✍ ✍ ✍

Boscoli Breakthrough

Many thanks for Issue No. 27 of *Infinite Energy* and many congratulations on yet another truly excellent edition of your journal. It is a superb blend of the recent history of science, with the most up to date news on new energy experiments and a frankly astounding piece of completely new scientific thinking with Renzo Boscoli's articles on the Sun.

I feel sure I am speaking for many people both in the scientific community and in the media when I say how much I admire your determination and persistence to publish the facts about new energy sources in the face of predictable hostility, especially from the hot fusion establishment. It would give me more joy than I can possibly express if Boscoli's theories were proved correct and the Sun turned out to be cold! Imagine sitting and watching the Discovery Channel while astrophysicists explain how we had made such a mistake!

More power to you and your colleagues at *Infinite Energy* and may we read many more such stimulating and original editions.

Richard Milton
Towbridge, England

✍ ✍ ✍

Japan Psychotronics Institute
2-2-2 Sekigawa-cho, Arai-shi, Niigata
9440-0014, Japan; Tel/Fax. 0255-72-0558

We have organized the Committee for New Energy Applications at the JTTAS, which is a non-profit organization permitted by MITI (Ministry of International Trade and Industry).

Dr. Beverly Rubik and Dr. Brian O'Leary are the overseas advisers of the committee. When Dr. Rubik visited Tokyo last month, she brought us a copy of your recent journal and suggested to us that you might be interested in reporting the CNEA activities. We appreciate your kind consideration.

Shiuji Inomkata, Ph.D.
Chairman CNEA/President JPI

Committee for New Energy Applications (CNEA)

Japan Technology Transfer Association (JTTAS), which is a nonprofit organization under the wing of Japan's MITI (Ministry of International Trade and Industry), has set up the Committee for New Energy Applications. The Chairman of the committee is Dr. Shiuji

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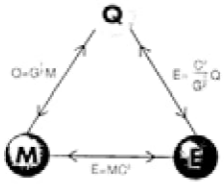
the Committee for New Energy Applications. The Chairman of the committee is Dr. Shiuji Inomata, JPI President and former MITI scientist. The purpose of the committee states that energy policies have been stalemated because of the environmental and global warming problems. That is, fossil energy such as oil causes global warming. Nuclear energy suffers from safety and nuclear waste problems. Also, solar, geothermal, and wind energies are believed not to be enough to power the whole nation. But, by the presentations and dis-

Dr. Brian O'Leary, Dr. Shiuji Inomata, and Dr. Beverly Rubik

cussions at the First and Second International Symposiums on Consciousness, New Medicine, and New Energy (1996 and 1998 in Tokyo), the existence and applicability of clean and limitless energy which has not been considered within the framework of conventional physics has become clear. This energy could be called Ki-Energy from the standpoint of Eastern philosophy, and its existence has become evident from the reorganization of the conventional physics. In view of these situations, this committee is to propagate the New Paradigm Science theories which can explain this new energy process and the R&D information about N-machine and other Over-Unity energy devices to industry personnel and MITI bureaucrats.

What is Ki-Energy ?

Conventional physics addresses only mass-energy categories. But Psychotronics is a new science which contains not only mass-energy categories, but also a consciousness (Ki) category. In Psychotronics, the energy conservation law of the conventional physics $E=MC^2$ is extended into the following triangular form:



Where M=mass, E=energy, C=light velocity, G=gravitational const., Q=shadow electric charge, Ki=consciousness. $E=MC^2$ is nuclear energy and $E=(C^2/G^{1/2})Q$ is Ki-energy. In 1986, the year of the Chernobyl nuclear disaster, Japan had thirty-three nuclear power stations and produced 245 billion KWh yearly, which means that about 10 Kg of mass was converted into energy according to $E=MC^2$.

According to Ki-energy $E=(C^2/G^{1/2})Q$, 2.6 CGS unit of shadow electric charge or Ki-quantity, if converted into energy, can supply the same amount of energy. The psychotronics theory stipulates that the vacuum is a balanced sea of both Yin and Yan Ki with infinite depth. Ki can be tapped unlimitedly and the ultimate energy device of non-fuel, non-pollution and non-waste could be realized.

Study Items of the Committee

1) New Scientific World-View/Paradigm of New Science/Psychotronic Theories/ Possibility of the Final Solution of Energy Problem by Ki-Energy (from $E=MC^2$ to $E=(C^2/G^{1/2})Q$
2) N-machine Theory and Its Experiment/ Other Over-unity Energy Devices
3) Superconducting Magnet for N-machine, Present and Future
4) Cold Fusion/Element Transmutation, Present and Future
5) New Gravitational Theory/The Possibility of Gravitational Control
6) What is Torsion Field?/ Non-thermal Cooling, Heating and Communication by Torsion Field
7) Suppression of Steel-corrosion by Ki-energy
8) Improvement of Fuel Efficiency and Waste Gas of a Car by Ki-energy
9) Psychotronics, Brain Function and Life Phenomena
10) Application of Ki-energy to New Medical Technology and Devices
11) Impacts of Ki-energy on Industrial Structure and Society

Committee Activities

1) Committee Meetings
2) Organization of Symposiums
3) Annual Research Report and Publications

Chairman: Shiuji Inomata, Ph.D., JPI President.
Committee Members: Takashi Aoki, Prof. Ph.D., Chubu University; Hideo Hirano, President, Holonic Management Lab; Osamu Ide, President, Clean Energy Lab Natural Corp.; Takahiko Tago, President, Inter-Science Lab; Takao Yamazaki, Senior Researcher, Nippon Steel Corp. Jun Akutsu, Science Writer Yoshiyuki Mita, JPI Member; Mitsuo Nakata, JPI Member
Domestic Advisers: Yasuo Yuasa, Prof. Emeritus, Obirin University; Shigemi Sasaki, Prof. Emeritus, Ph.D., University of Electro-Communications
Overseas Advisers: Brian O'Leary, Ph.D., former Prof. Princeton University, Hawaii,

Letters/CNEA—See page 25

"Websites Worth Your While"

http://www.global.org/jphogan
The website of hard science fiction writer James P. Hogan, friend of cold fusion and alternate science. Interesting reading indeed!

http://www.alltheweb.com
A really high speed web search site. We use this, particularly in the lab.

http://www.entropysystems.com
The place to go to learn about the Amin cycle and its flouting of the accepted laws of thermodynamics.

http://www.sightings.com
Jeff Rense brings you a wide selection of odd news and strange stories from around the globe. A real cornucopia for those who are interested in everything.

—JDK

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❋ Experimental Results in Cold Fusion and New Energy
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Submit to: Dr. Eugene Mallove, Editor-in-Chief *or*
Barbara DelloRusso, Managing Editor
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The document files are searchable for key words and phrases using the Adobe Acrobat Reader 3.0.1 with the search engine option which is provided with the FIC CD-ROM package as a separate disk. The CD-ROM contains:

Full Text Documents
Fusion Facts: July 1989-December 1990, December 1996
Journal of New Energy: January 1996-Fall 1998
Cold Fusion Source Book, May 1996, 313 pgs.
New Energy News: January 1997-Nov/Dec 1998

Bibliographies
Fusion Facts: July 1989-December 1996
Fusion Facts Abstracts: January 1996-June 1999
Journal of New Energy: January 1996-Spring 1999
New Energy News: May 1993-May/June 1999

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Jeffery D. Kooistra

Diamonds in the Rough

"If you keep a thing seven years, you are sure to find a use for it."

Sir Walter Scott

We're starting up a new division here at NERL (New Energy Research Laboratory), though we're not quite sure what we'll call it. "GEM" seems like a good acronym—it stands for "General Electromagnetics." We might also add on an "Incorporated" or an "Industries" to make it "GEMI." Regardless, we expect to produce no shortage of technological gems in the coming months and years.

I had hoped to "reveal all" about the Marinov Motor and the Warlock's Wheel this issue, but upon consultation with our patent attorney, it was deemed more prudent to hold back for a short while yet. We do want to get a "Warlock's Wheel Kit" to the market as soon as we can, so we won't let patent issues delay us too long—not more than an issue or two.

It was fun showing off my various motors, both to potential sponsors and the patent attorney. We've had quite a flux of such come through our doors this past month. What made it fun was that these motors are basically constructed out of junk I either had laying around my basement or that I picked up at the hardware store. Apart from magnets and wire, I seldom have gone far afield for construction material.

You're all familiar by now with the infamous Warlock's Wheel—the housing for it is just a Styrofoam coffee cup. But just a glance at some of my more advanced motors reveals their mongrel pedigree.

One motor I showed off I call the KLP motor (for Kooistra-Ligon-Phipps). Apart from the magnets and wire, it is made from such "quality parts" as:

- a plastic beam from a childhood construction toy
- a piece of particle board I saved from some other project
- two pieces of hardwood I saved from a project of my brother-in-law's
- glued together plastic sheeting recovered from the trash at a previous job
- bearings fashioned from pieces cut from nylon fittings
- an empty sewing thread spool
- specialty medical foam tape

and a few other items.

Those of you who read my last column will recall how my friend Scott had put together his own railgun rig from a similar ramshackle collection of things. This led Dr. Peter Graneau himself to suggest we start thinking about "saw horse experiments which play havoc with quantum electrodynamics."

A great many of the experimenters with whom I come into contact have long ago learned that good and groundbreaking physics can be done in the basement or the garage. What most of them have also come to know is that a great deal of that good research can be done with items one probably already has on hand. Granted, those kinds of folks who would actually dirty their hands with experimental physics probably already have dirtied their hands with other projects, the remains and leftovers of which almost certainly did not get thrown out. (An aside here—Gene Mallove is even more of a packrat than I am—when I moved, I brought along a lot of what I thought was "good junk." However, upon seeing the extreme to which Gene had taken pack-rattery, I literally threw out stuff I'd kept for twenty-five years despite having just moved it a thousand miles across the country.)

Like I said, we're setting up a new division here. Ed Wall and I went shopping recently for some things we'll need. Since we were going to an appliance store, I also used the occasion to pick up a new television set for home. Of course, the old set is now right here in the lab—we have uses to make of the electron gun in the picture tube. I also recently dismantled an ancient transformer I saved from my Dad's TV repair days—we needed the laminated core. Have I mentioned before that I have hundreds of old vacuum tubes in my office, also courtesy of my Dad? Well, I do—still stored in the gray treasure chest he built to take with him to repair jobs.

Of course, no matter what you have on hand, you sometimes still need to shop. One of our sponsors was quite amused with what I could wring out of old junk. But he sure understood my current needs and my current projects. He recently sent me some model train magazines with ads highlighted in them for stuff and companies I might find useful. I think I've ordered something already from almost every ad.

Some martial artists claim they can turn almost anything into a lethal weapon. This is also true of the extreme physicist, although in that case, he can turn almost any collection of worthwhile junk into a paradigm-killing demonstration.

My purpose for writing this column is not to preach to the converted. You experimentalists out there already know just how rich a mine the junkyard can be for your work, and which of you hasn't put something from the plumbing supply store to a use that no plumber would ever have conceived of? But I do want to strongly encourage the new readers and the young scientists out there, and perhaps even the older newly-retired scientists who've just lost access to their corporate or government lab, that a lack of "conventional laboratory supplies" is no excuse for not pursuing interesting science.

Indeed, just as those of us who explore science beyond the cutting edge have found riches in old theories long since cast away, we've built our vehicles of exploration out of junk long since banished to boxes in the attic or to corners underneath the stairs to the basement. ❑❑❑

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The Tragedies of Renzo Boscoli and "Warm Fusion"

by Eugene F. Mallove

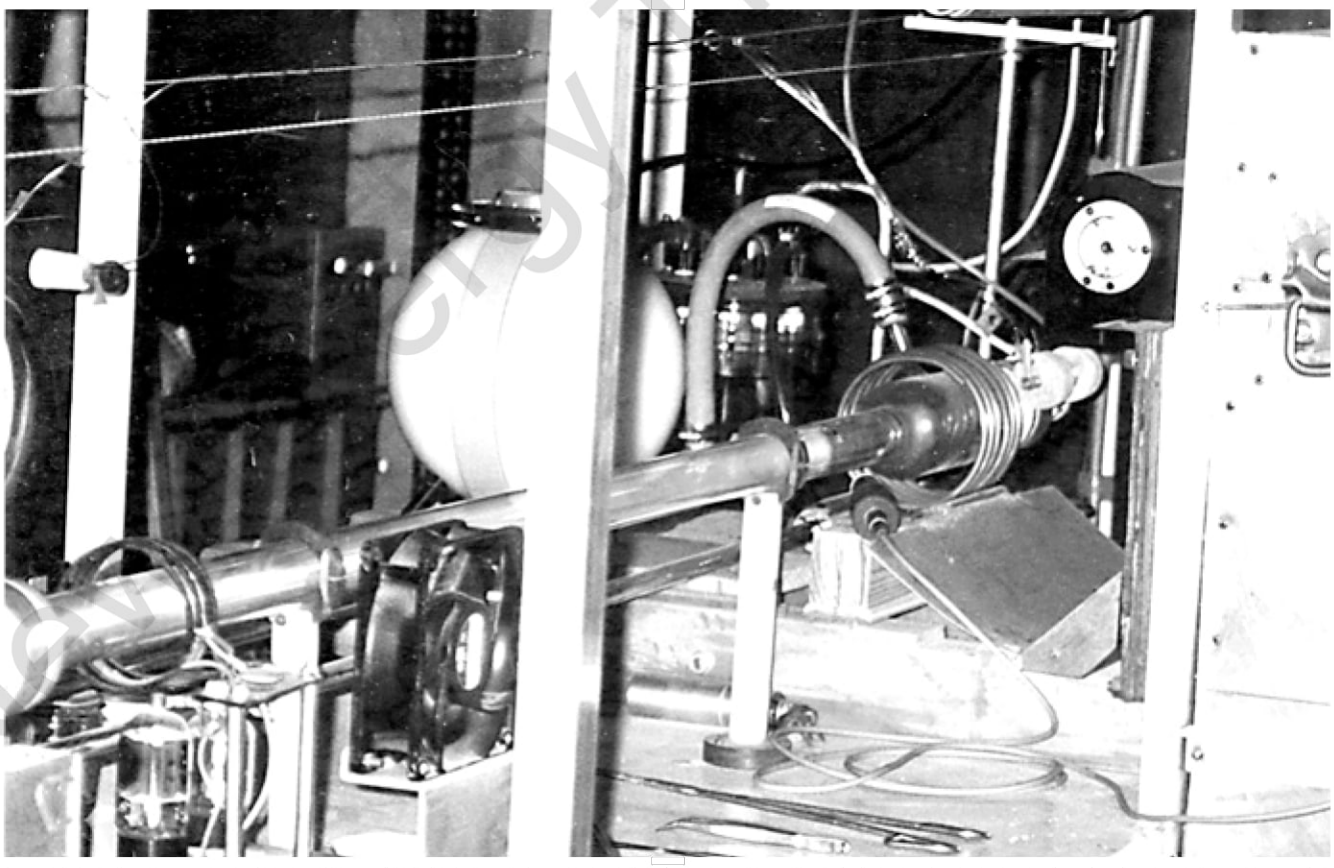
In Issue No. 27 of *Infinite Energy*, we gave Renzo Boscoli the opportunity to publish his theories of low-energy nuclear reactions, which he suggests explain the Sun's fusion processes. We were not at all convinced that he could revolutionize solar physics with these theories. Nonetheless, we were impressed by his statement that he had performed experiments that produced excess heat and nuclear effects. These, he claimed, validated his theories. He also provided a general characterization of what his experiments had achieved: "1) A reaction heat with temperatures exceeding 1,000°C within seconds of initiation; 2) Emission of extremely short-wave electromagnetic radiation; 3) Gamma radiation emission; 4) Neutrons at 100 times background and beyond; and 5) Power generation sometimes exceeding 1,000% over-unity."

Shortly before going to press with Issue No. 27, we learned that he had already applied for an international patent on this process and that this application had resided on the web at the IBM patent server site for some time [http://patent.womplex.ibm.com—Pat. No. WO 9843249] (apparently unnoticed by anyone in cold fusion)! For your convenience, this patent *application* (which is not yet approved) is reproduced here (p. 14). The patent application describes a low-energy accelerator tube that uses a deuterium ion beam in vacuum to bombard a special solid target made of various sulphate salts (typically copper, lithium, and titanium sulphates) that are hydrated with heavy water. It was disturbing that we had not been told by Boscoli's close American colleague Mr. David Cappelletti, CEO of Paradigm Energy Corporation, that this application had been a matter of public record for over a year earlier. Why all the secrecy about something on the web? This bizarre behavior, it turned out, was a portent of bad things to come.

The experiments were claimed to produce quite dramatic, fairly regular excess heat at ratios of over 10:1; clear evidence of nuclear products such as neutrons and tritium, and a temperature high enough to melt metal components of the reactor on several occasions. We were told that Mr. Boscoli was extremely reluctant to show these experiments widely, although it was also said that well-known cold fusion scientist Dr. F. Scaramuzzi of Italy had seen one test some years ago which supposedly "frightened him," perhaps by the intensity of its glow and meter evidence of neutron production.

After lengthy discussions with him, David Cappelletti persuaded Boscoli to allow an on-site visit by me to witness these heat-producing "warm fusion" experiments first hand. I went to Boscoli's country laboratory some 50 kilometers from Bologna, Italy. I did this with considerable enthusiasm, although it was inconvenient, since I had a previous speaking engagement in Colorado just before the scheduled visit to Italy and this would make me miss the Fourth Asti Workshop on Anomalies in Hydrogen/Deuterium Loaded Metals, also in Italy.

I visited Boscoli's lab on October 25 and 26. I was well-prepared. I brought precision instruments to help evaluate his methods of power measurement and calorimetry. I am saddened to have to file this big let down report to the many readers who may have been buoyed by my earlier enthusiasm for the process, based on what I had assumed were well-grounded experiments by Boscoli and Cappelletti. Tragically, I discovered there is no way (short of laboriously duplicating his entire experiment based on the patent, which omits some needed



"Warm Fusion" apparatus in Renzo Boscoli's laboratory. Deuterium ion beam comes from left, travels down accelerator tube, passes through aluminum focuser and hits deuterated target in expanded glass section. BF_3 neutron detector is encased in white polyethylene sphere. Operating conditions shown are intended for neutron production, not excess heat. *(Photo: David Cappelletti)*

Renzo Boscoli's country laboratory (left) is in an upgraded barn in a sugar-beet field. His 1933 vintage house at right. *Photos this page: Eugene Mallove.*

details) that I or anyone else can say whether Renzo Boscoli has *ever* found any experimental evidence for excess heat or anything else of an unusual "new physics" nature with his "warm fusion" equipment. The explanation of this blunt conclusion is quite simple. When I got to Italy, I learned that *no* excess energy experiment would be shown to me during my visit. Boscoli adamantly refused to show me *any* technical evidence from previous experiments that would allow me or anyone else to assess what he had achieved or had not achieved! I was flabbergasted and terribly depressed. Before I left on this investigative field trip, Cappelletti asked me to fax him a list of technical questions for him to discuss with Boscoli (see inset). When I arrived, Boscoli flatly refused to answer any of these questions, and Cappelletti says he probably never will answer them. Boscoli and Cappelletti knew that I was evaluating Paradigm Energy on behalf of investors, and that if I had made a positive recommendation it would have led to significant funding for the company, yet they stonewalled me.

David Cappelletti

Renzo Boscoli is a tragic figure. On the one hand he desperately wants recognition. However, he trusts almost no one from outside and may well have some fear that "the Americans" will steal his process. He believes some of his other technological ideas have been purloined. Boscoli's excess heat "discovery," if it is real at all, apparently remains hidden by him in "coded" notebooks that Cappelletti as CEO of Paradigm Energy Corporation is not allowed to see! He does not even know where they are. This is utterly preposterous and tragic for Mr. Cappelletti, his associates, and his family.

It is difficult for me and our devoted readers to understand the new direction that Boscoli is taking. The ostensible reason provided by Cappelletti for this dramatic turn was that Boscoli was at this time working on new experiments with his "warm fusion" reactor, which were aimed at generating copious neutrons, *not* excess heat. He had told Cappelletti and me that he has intentionally departed from achieving excess heat. Moreover, he stated quite emphatically to Cappelletti that he will never go back to the "obsolete" excess heat-generating process—heat was for 19th century steam engines! For what reason? The claim was that the old process was not reliable enough, that he now had a new idea that he could somehow generate neutrons that could be converted to electricity by going to lower voltages in his deuteron accelerator tube, 400 to 800 volts versus the several thousand volts that he had been using to generate alleged excess heat.

Questions Faxed to Cappelleti and Boscoli—October 14, 1999

The following are critical pieces of information that I want to know that will greatly help accelerate the critical reproduction activities that will be underway in the U.S.—both here in Bow and elsewhere. Much of this information will be of extreme interest to our readers too:

• What is the current method of measuring the input power to the process?

• What are the current method(s)—I hope that is in the plural for cross-checking purposes—for measuring the process thermal output power?

• If electrical output power has already been achieved, how is this power being measured?

• What total (absolute magnitude) output power is generated routinely? Have there been higher-power excursions?

• What is the range of estimated power density in the target?

• What is the typical duration of a high power ratio run—minutes, hours, days, weeks? What is the longest continuous excess-power-producing run ever achieved?

• You say that the experiment is 100% reproducible. In what sense is this so given that the "toggle point" has not been reached? I assume this means that radiations are always present even in non-massive heat-producing runs.

• Has the potential chemical release energy of the sample reacted with hydrogen been calculated for the sake of completeness? If so, what is the maximum chemical energy release per gram of target?

• A few common theme questions have been received from those contemplating reproduction attempts: How is it possible to preserve the necessary high vacuum conditions in the face of out-gassing by a high temperature target? Does not the deuterium in the target leave the target quickly?

• Have "control" experiments been done in which the target hydration water is not heavy water but light water? If so, what were the results? Have proton beam "control" experiments been attempted? If so, what were the results?

• Have "control" experiments been run without lithium salts present in the target? If so, what were the results?

• I am interested in examining what nuclear emanations have been measured, though on this trip this is of less concern than the power input and output measurements. I would like to find out exactly how the tritium, the gammas, and the helium are being measured.

I am bringing with me to Italy the following test equipment, which I hope to find some use for in characterizing the process with independent instrumentation:
— A digital volt meter (a DVM)
— An in-line ammeter, a dual-probe thermocouple, for measuring inlet and outlet water temperature, if that kind of calorimetric test can be run while I'm there.
— A Raytek, Raynger 3i high-temperature infrared remote temperature measuring device (arriving here next Monday for $2,145). It has a temperature measurement range from 600°C to 3000°C. It has a cross-hair sighting scope for precise alignment with the target.
— A small sampling bottle for output gases that might contain helium. SRI International will be able to read the helium sample for us if we send it to them.
— A video camera and still camera in the event that Signor allows historic footage to be made—footage that would be greatly appreciated by us and Sir Arthur C. Clarke.

If Renzo is preparing a few-page write-up on his views of his experiments that I could include with my report for *IE* No. 28, it will be critical that I get a clear English translation of this while I am there. There will be no time to include it in No. 28 afterwards. I would even like to e-mail it to Barbara while I am there in Italy— I would manually enter it into my laptop while I'm there if you do not have a disk version.

That is all for now. I am eagerly looking forward to my trip to Bologna from October 24th through the 29th and hope that I will be thoroughly overwhelmed, as

This struck me as extremely unwise and strange—especially since I made it absolutely clear in advance that excess energy was what I and *Infinite Energy* readers most wanted to hear about based on the article in Issue No. 27. (Boscoli, I was told, had agreed only reluctantly to that article, yet was happy with

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the final version.) I cannot imagine any reasonable way to easily convert high-energy neutrons directly and efficiently into electricity. Boscoli boasted that he could do this within the next few months. (The hot fusion community had not been discussing any such process—these chaps would certainly have done so could they have imagined one, because tokamak hot fusion certainly could use such a process.) Furthermore, the entire cold fusion field of which this "warm fusion" was supposedly a part had found relatively aneutronic heat-producing reactions. Beyond that, how would it be possible to convert large numbers of neutrons to electricity efficiently enough to have even a remote chance of equaling—much less exceeding—the input electrical power to the process? Any significant flux of neutrons, certainly at the watt-level or above, would be extremely hazardous.

I began to have the sickening feeling, born out by later results and observations, that this Boscoli work may be a complete illusion—the product of overly enthusiastic and insufficiently skeptical imaginations. David Cappelletti is certainly well-meaning. He has marshalled considerable financial resources from his own family and others to support Renzo Boscoli all these years—far in excess of $500,000 I was told. Cappelletti met Boscoli in 1991-92 while he was working as a medical student in Italy, doing technical translation on the side. Cappelletti, a charming, fluent Italian-speaking American from Indiana, had put his medical career on hold to help Boscoli all these years. I had talked with David on and off ever since meeting him at the Fifth International Conference on Cold Fusion (ICCF-5) in Monte Carlo in 1995. It was not going to be easy for him to realize how misdirected he may have been. Recalling how often I had heard from Cappelletti in the past at cold fusion meetings about the mysterious unnamed process that was "extremely hot" and "intuitive," I realized that I might have been able to save him and others considerable grief by evaluating the process long ago. Sadly for Cappelletti, Boscoli had him under his nearly complete control these years. Cappelletti had been dangerously accommodating to Boscoli. This was not "pathological science" in the sense that Irving Langmuir defined it, but it certainly is isolated, misguided science that had been performed without the assessment of friends and experts in experimental measurements—excess heat and nuclear products. In truth, we simply do not know at present whether there is anything of value in the Boscoli process. It is still possible that it is a remarkable breakthrough, but it is being grossly mishandled if it is.

My conclusion after this trip is that unless Boscoli publishes clear scientific evidence that he has something and gives other people a reason to reproduce his work, it would not be productive for them to pursue replication efforts—although they are welcome to try, if they wish, based on the patent and some small new information I was able to learn. Furthermore, Paradigm Energy Corporation should not seek additional investors unless it provides them access to the necessary scientific evidence to judge whether the process has merit.

When I was in Boscoli's lab, I examined the experiment that was supposedly producing neutrons. I could see that the Eberline BF_3 neutron detector (Model ASP-1) had an approximately six-meter cable that ran from the spherical polyethylene detector head near the "warm fusion" target to the analog meter electronics. It could detect fast (high-energy) neutrons—thermalized for the detector by the polyethylene. As the glow discharge (from an induction ionization coil and the electric field accelerator) occurred in the low-pressure, deuterium-filled glass tube (vacuum gauge read 32.0-39.0 x 10^{-5} torr), the Eberline meter appeared to record what would have been huge numbers of neutrons per hour. The high end of the scale that would peg at its maximum at these times read a nominal 25,000 to 250,000 mrem/hour (depending on the scale setting). This, if real, would have been an extremely dangerous neutron exposure. Fearing these perceived neutrons, Boscoli had arranged cadmium plates, lead shielding, and paraffin shielding near the polyethylene-moderated tube in an effort to provide some safety.

I am no neutron expert, but the whole scene did not inspire confidence. I assumed that there was a very good chance that the apparent high neutron signals might actually be electromagnetic interference in the detector cable. The meter pulsations occurred in synchrony with the periodic glow discharges as Boscoli adjusted the vacuum in the accelerator tube. I asked for another meter to be brought on site. David Cappelletti was accommodating and arranged for physics Prof. Sergio Focardi from the University of Bologna to come to the lab the next day (Tuesday, October 26) with his battery-powered, integrating BF_3 neutron detector.

The only conclusion one could draw based on the use of the two detectors is that significant neutron production probably does not exist. It is certain there was EM interference in the Boscoli detector with that six-meter coaxial cable. That was also the basic assessment of Focardi (who thought that there could be some very low neutron production, but how much was not clear). His detector, being battery-powered, digital, and with no long cable, was not subject to as much EM interference. Boscoli might actually be producing repeatable low-level neutrons. If he is, then this is a remarkable repeatable experiment of value. I believe that Focardi's detector is more trustworthy—registering much lower levels of neutrons—at subfractional mrem/hr (usually at 0.001-0.004 mrem/hr; maximum at about 0.7 mrem/hr) as gathered from 5-minute samples. But even these may represent EM interference.

Boscoli could not possibly have lit a small light bulb (a "lampadina") *from neutrons*, as he had claimed. Even if his very tiny signal in the sub-milli-rem/hr range was a true indication of neutrons, this would not have been able to light any light bulb. If there had been any bulb-lighting from a higher level of neutrons, the energy of these neutrons would likely have given him a serious irradiation by neutrons.

I repeat, there was *no* heat experiment to check out since Boscoli had gone to a new type of target and lower voltage—some 400-800 volts, he said, with his rather poor analog meter instrument that pegged at a low-end voltage a bit over 800 volts. I saw his beam current meter usually at the several mA level, though occasionally up to 100 mA. There was no point in making elaborate power measurements under these circumstances.

What ever led Boscoli and Cappelletti to imagine that they had achieved excess power in their previous experiments? It is quite clear, for one thing, that they were impressed by the occasional melting of an aluminum structure, the so-called "focussing tube," and the intense glow that they observed in what they assumed were excess heat experiments. I had asked Cappelletti to get actual data from Boscoli's calculations (or whatever other quantitative evaluation he used) so that at least I could include that data in this paper, but such data has not arrived as of November 1. Incredibly, Cappelletti told me that he did not know how Boscoli evaluates his excess heat. Melting occurred four times and I did see a melted component. Melting occurred in the purely geometric (not electrically active) aluminum focuser that was several inches away from the target

Boscoli—See page 42

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The Sun is Not a Hot Fusion Reactor

Harold Aspden
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www.energyscience.co.uk

I applaud the "bombshell" of the September 1999 issue of *Infinite Energy*. At last we can see sense emerging on the question of what is the power behind the Sun. We cannot see inside the Sun. Its surface has a temperature of 5800°K and it is said that there is an enveloping hazy corona region that exhibits a temperature of the order of 1,000,000°K, but we know that the Sun's sustained energy radiation comes from whatever process it is that sustains that lower surface temperature. It is logical to suspect that the solar corona region is the seat of electrical discharge activity involving the kind of electrodynamic pinch action that was featured in the early ZETA fusion reactor research and did lead to the sporadic events exhibiting that 1,000,000°K temperature and optical spectra that one sees in the solar corona, yet was insufficient to trigger a fusion reaction. The heat produced at that temperature is presumably conducted down to the Sun's surface and is ultimately shed into space as radiation. We really need, therefore, to search for a reason as to why powerful electric fields exist in the solar atmosphere and wonder if they can draw on a field energy resource hidden in the coextensive underlying sea of action we associate with quantum physics.

Scientists involved in hot nuclear fusion research thrive, however, on the belief that the core of the Sun has a temperature measured in tens, if not hundreds, of million degrees, all because they assume that their achievements in inventing the hydrogen bomb have replicated a process that is ongoing in the very center of our Sun. They are quite wrong in this assumption and it may be that enlightenment is at hand with the more relevant "bombshell" we see reported in Volume 5, Issue 27 of *Infinite Energy* by reference to the findings of Renzo Boscoli.

It may be of interest to readers of *Infinite Energy* if I point my finger at the circumstance in history where physicists took a wrong turn and began to head down the blind alley that was to lead them astray as they probed in their imagination the inner workings of the Sun. The prospect of stars heated by atomic power was in the mind of physicists in the early 1930s. Renzo Boscoli on page 13 of that issue of *Infinite Energy* drew attention to the role Eddington played in fostering this notion. Boscoli tells us that the fact that the "superbomb" really worked vindicated such speculation about the solar heat source.

In spite of that, I now quote a single paragraph from a book published in 1935 by Cambridge University Press. Sir Arthur Eddington on page 155 of the work *New Pathways in Science*, after explaining how the material of the Sun is very far from its limit of compressibility and so could be assumed to be a perfect gas, then wrote:

> Before this explanation could be accepted it was necessary to examine the effect of electric charges of the ionised atoms. The effect is found to be small and actually tends to make the material slightly more compressible than a perfect gas. This sounds paradoxical, for you would think that it would be more difficult to squeeze together ions which repel one another than complete atoms which are electrically neutral; but it must be remembered that the electrons which have been torn from their orbits are still present in the material, and they are able to compensate the nuclear charges as effectively as if they were bound.

Such was the reasoning, clearly expressed in those last few words by Sir Arthur Eddington, Professor of Astronomy and Experimental Philosophy at Cambridge University, that was to lead generations of nuclear physicists astray in their false belief that the Sun is a nuclear fusion reactor having a core at the very high temperature needed to promote hydrogen fusion.

On what basis, I ask, can Eddington say that when protons and electrons become free from their atomic bond they still hold together "as effectively as if they were bound"? Two protons are subject to a rate of mutual gravitational attraction that is 1836 times stronger than the corresponding gravitational attraction between two electrons. The ionized plasma produced, once hydrogen is put under a pressure sufficient to bring into collision the electron K-shells of the atomic electrons, will find that its proton population is very slightly displaced radially inwards inside the Sun so as to set up a positive electrical charge density compensated by an outer bounding shell of negative electron charge. The repulsive electrostatic forces in that positive charge system must balance exactly the gravitational effects within that plasma. In short, the Sun will have a uniform mass density set by that threshold at which the hydrogen gas brings the atoms into contact. Just work it out yourself and compare the result with known data for the Sun's mass! The diameter of the electron K-shell of the hydrogen atom is a little above ten nanometers, so you can count on there being of the order of 10 raised to the power 24 such atoms in a cubic centimeter, each of known mass of approximately 1.6 times 10 raised to the power minus 24 gm. One then sees that the mass density is slightly less than 1.6 gm/cc, which compares with the Sun's known mass density of 1.4 gm/cc.

Note that I am not here talking about an equilibrium state set up inside the Sun by heat radiation pressure being in balance with gravity forces, an Eddington proposition duly noted by Renzo Boscoli. No, I am talking simply about the inwardly directed gravity forces acting preferentially on the free proton population to set up a positively charged plasma inside the Sun and finding equilibrium with the mutual electrostatic repulsion. Eddington failed to see what was obvious, owing to his false assumption that in a plasma of free electrons and free protons those charges stay together in pairs "as effectively as if they were bound together" within their parent hydrogen atoms.

How could Eddington have been so deceived in his thinking that he missed seeing this vital evidence and did not wake up to the fact that the free protons see one another as a mutual gravitational influence separate from and far stronger than that applicable if they were truly held in atomic bondage with electrons? I can only suppose that he was, in writing page 155 of his book, paving the way for his chapter on "Subatomic Energy," beginning on page 160. He had assumed that the Sun must be a very hot nuclear furnace and he wanted gravity to act on those atoms to pull their nuclei much closer together, just as if they remained intact, notwithstanding the state of ionization, so that he could justify compression to a very high pressure and a very high temperature condition that could be the trigger for nuclear fusion.

In his book he made no mention of the earlier findings of A. Schuster or H.A. Wilson. The Schuster-Wilson Hypothesis, based on observational data, conveyed the message that a star, in rotating, exhibits magnetism as if its magnetic moment arises from the rotation of an electric charge of magnitude proportional to its mass. The ratio observed is exactly that expected if the electrical charge density is compacted throughout the star just enough to balance gravity. I regard that omission by Eddington as very unfortunate, given his influence at the time. Here was a cosmological phenomenon that had powerful implications for those who theorize about the inner constitution of stars. It was a phenomenon that contradicted the notion that unrestrained gravitational forces are at work and are such as to trigger hot fusion reactions in the inner core of a star.

World War II years then intervened, with its impact upon our atomic age, before Nobel Laureate Blackett, at the University of Manchester where Schuster had done his pioneering work, revived interest in the Schuster-Wilson Hypothesis. It seemed that more astronomical data was emerging and confirming the hypothesis. Blackett drew this to attention and set about devising an experiment to test the hypothesis in the laboratory. Then we witnessed another detour by a scientist taking the wrong turn! Blackett reasoned that a massive spherical object, in rotating, could set up a magnetic field of the magnitude claimed by the hypothesis. Wilson had already detected a magnetic field that he could not eliminate in his experiments involving rotating discs. Blackett had magnetometer test equipment so sensitive that he could keep his test body at rest and let its rate of rotation be simply that of body Earth but any kind of vibration had to be avoided. He used a large, solid gold ball, assuming that its high mass density would concentrate the effect of the phenomenon, making it easier to detect and so reveal that predicted relationship between the induced magnetic moment and angular momentum. He obtained a null result, but where had he gone wrong? Well, simply put, he had not, in effect, captured a star for his

Aspden—See page 17

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International Application Published Under the Patent Cooperation Treaty (PCT)-Boscoli

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International Appl. No.: PCT/IB98/00388
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Method and Machine for Producing Energy by Nuclear Fusion Reactions

Abstract

An experimental machine (see Figure 1) for producing low-temperature nuclear fusion reactions, wherein an ion source (3) feeds a flux of positive deuterium ions to a reaction chamber (2) housing a target (5) defined by active elements (30, 31) and by an aggregate of metal sulfates hydrated with heavy water; a pumping assembly (4) being provided to maintain a vacuum in the reaction chamber (2); and the reaction chamber (2) having an accelerating device (10) for accelerating the positive deuterium ions, and which generates an electric field inside the reaction chamber (2) to convey and accelerate the deuterium ions against the active element of the target (5) in such a manner as to initiate nuclear fusion reactions between the incident deuterium ions and some the the atoms of the active element.

Technical Field

The present invention relates to a method of producing energy by nuclear fusion reactions.

Background Art

The general consensus in most scientific circles is that neutron emission in itself is incontrovertible proof of the nuclear fusion of two deuterium atoms, or of one deuterium and one tritium atom.

Disclosure of Invention

It is an object of the present invention to confute this assumption by showing that preliminary and/or simultaneous emission of neutrons and gamma rays is an essential condition for nuclear fusion reactions between deuterium and tritium atoms to take place. In other words, it is an object of the present invention to show that the deuterium/tritium nuclear fusion phenomenon is invariably preceded and/or accompanied by the deuterium/deuterium nuclear fusion phenomenon.

According to the present invention, there is provided a method of producing energy by nuclear fusion reactions, and comprising the steps of:

— feeding a flux of positive deuterium ions to a reaction chamber containing a target having deuterium atoms in its crystal lattice and active metal elements; and

— conveying, inside the reaction chamber, said flux of positive deuterium ions towards the target, so that the flux of positive deuterium ions strikes the target to produce nuclear fusion reactions between the incident positive deuterium ions and some of the atoms constituting the target itself.

The present invention also relates to a machine for producing energy by nuclear fusion reactions.

According to the present invention, there is provided a machine for producing energy by nuclear fusion reactions, characterized by comprising a reaction chamber; a target housed inside said reaction chamber; a positive deuterium ion source communicating with said reaction chamber; and a pumping assembly communicating with said reaction chamber to maintain a vacuum inside the reaction chamber; said target having deuterium atoms in its crystal lattice; and said positive deuterium ion source feeding a flux of positive deuterium ions into the reaction chamber, so that said flux of positive deuterium ions strikes all the elements of the target to produce low-temperature nuclear fusion reactions between the incident positive deuterium ions and the atoms constituting the target itself.

Best Mode for Carrying Out the Invention

Number 1 in Figure 1 indicates as a whole a machine for producing energy by low-temperature nuclear fusion reactions, as distinct from hypothetical "thermonuclear" reactions.

Machine 1 comprises a reaction chamber 2; a positive deuterium ion source 3 for feeding a flux of positive deuterium ions (deuterons) into reaction chamber 2; a known pumping assembly 4 for maintaining a relatively low pressure inside reaction chamber 2; and a target 5 housed inside reaction chamber 2, and which is struck by the flux of positive deuterium ions fed into reaction chamber 2 by source 3.

Reaction chamber 2 is preferably, but not necessarily, cylindrical, extends coaxially with a reference axis 6, and communicates with positive ion source 3 and pumping assembly 4 via respective connecting conduits 7 and 8, each of which is connected to reaction chamber 2 at a respective end 2a, 2b of reaction chamber 2. In particular, conduit 7 connecting reaction chamber 2 to source 3 is so connected to end 2a of reaction chamber 2 that said positive deuterium ions are fed into reaction chamber 2.

With reference to Figure 1, reaction chamber 2 is connected to an ion accelerating device 10 for generating an electric field inside reaction chamber 2 to accelerate the flux of positive ions towards target 5. Accelerating device 10 comprises a pair of electrodes located at the two ends 2a, 2b of reaction chamber 2; and an electric energy source 11 for maintaining a given difference in electric potential between the two electrodes. One of the electrodes, indicated 12, is located at one end of and penetrates chamber 2, and the other electrode is defined by target 5, which is housed inside reaction chamber 2, close to end 2b of reaction chamber 2.

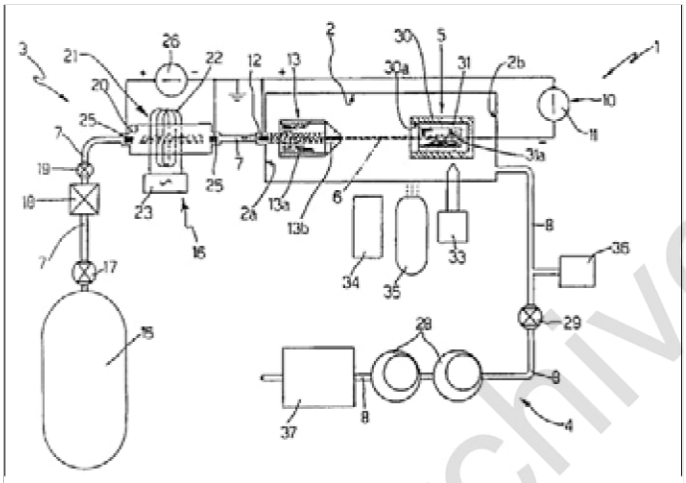

Figure 1. Schematic view of a machine for producing energy by nuclear fusion reactions in accordance with the teachings of the present invention.

In the example shown, reaction chamber 2 is made of Pyrex® glass, and houses a focusing device 13 close to target 5. Focusing device 13 is made of metal material, is insulated electrically from electrode 12 and target 5, and provides for concentrating the flux of positive deuterium ions on target 5. More specifically, focusing device 13 is divided into two portions 13a and 13b, the first of which faces electrode 12 and in defined by a cylindrical tubular body extending coaxially with reference axis 6, and the second of which faces target 5 and is defined by an ogival body coaxial with reference axis 6 and having a through hole with an inside diameter much smaller than the inside diameter of the cylindrical tubular body defining portion 13a.

In the example shown, source 3 of positive deuterium ions—hereinafter also referred to as "deuterons"—comprises a known tank 15 for storing gaseous deuterium, and which communicates with reaction chamber 2 via conduit 7; and a known ionizing unit 16 for ionizing the deuterium from tank 15 to form the flux of positive deuterium ions to be fed into reaction chamber 2.

Positive deuterium ion source 3 also comprises, in sequence, a known on-off valve 17 located along conduit 7 to permit and cut off supply of gaseous deuterium from tank 15; a known pressure reducing device 18; and a known mini on-off and regulating valve 19. Reducing device 18 provides for maintaining a given pressure of the gaseous deuterium from tank 15.

More specifically, ionizing unit 16 comprises a substantially cylindrical ionizing chamber 20 located along conduit 7; and a device 21 for generating high-frequency electric oscillations, and in turn comprising a coil 22 of electrically conducting material wound about ionizing chamber 20, and a power supply 23 for inducing a high-frequency electric current in coil 22 to generate inside ionizing chamber 20 an electromagnetic field capable of ionizing the gaseous deuterium from tank 15.

Ionizing unit 16 also comprises an ion accelerating device for generating an electric field inside ionizing chamber 20 to convey the flux of positive ions generated inside ionizing chamber 20 to the portion of conduit 7 communicating with reaction chamber 2. The accelerating device comprises a pair of electrodes 25 located at the two opposite ends of ionizing chamber connected to conduit 7; and a source 26 of medium-voltage electric energy, for maintaining a given adjustable difference in electric potential between the two electrodes 25.

In the example shown, electrode 12 is connected electrically to the electrode 25 located at the inlet of the portion of conduit 7 connecting ionizing chamber 20 to reaction chamber 2.

Pumping assembly 4 is defined by a pair of known vacuum pumps 28 (one rotary and one diffusion pump) connected to reaction chamber 2 by conduit 8 via the interposition of a known on-off valve 29 for selectively isolating reaction chamber 2 from pumping assembly 4.

With reference to Figures 1 and 2, target 5 comprises a preferably, but not necessarily, cylindrical outer casing 30, which is substantially cup-shaped and coaxial with axis 6 with its cavity 30a facing focusing device 13; and a substantially cup-shaped active element 31 housed inside casing 30 with its cavity 31a coaxial with axis 6 and facing focusing device 13.

In the example shown, casing 30 is itself also an active element, and is defined by a stack of alternating washers 32 of different metals (*e.g.* copper, titanium, iron, nickel, and/or other metals of similar chemical-physical characteristics) held together by gripping elements (not shown) such as longitudinal screw ties.

Active element 31 is defined by a compact aggregate of metal salts, in turn defined by a number of powdered metal sulfates (*e.g.* copper sulfate, lithium sulfate, titanium sulfate, potassium sulfate, etc.) mixed together with the addition of

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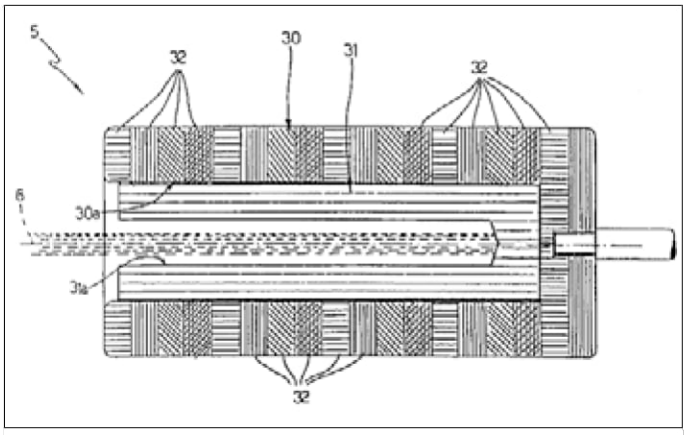

Figure 2. Section of a detail of the Figure 1 machine.

catalyzing and/or binding elements to improve the compactness of the aggregate. The copper and lithium sulfates are hydrated with heavy water (D_2O).

Each metal salt hydrated with heavy water (D_2O) is obtained from a corresponding metal salt hydrated with water (H_2O), *e.g.* $CuSO_4 \bullet 5H_2O$, which is first placed in an oven at a temperature of about 250°C until all the water (H_2O) molecules are eliminated, and is then placed in a silica gel dryer (known type) in which the salt is recrystallized in the presence of heavy water (D_2O) to obtain a corresponding metal salt hydrated with heavy water (D_2O), *e.g.* $CuSO_4 \bullet 4D_2O$.

Titanium sulfate is preferably, but not necessarily, used as a catalyzing element, and a silicone resin or alkaline alkylsiliconate dissolved in heavy water (D_2O) is preferably, but not necessarily, used as a binding element.

A first possible composition of active element 31 includes:

0.278 moles of $CuSO_4 \bullet 4D_2O$;
1.853 moles of $LiSO_4 \bullet 0.8D_2O$;
0.0625 moles of $TiOSO_4$; and
q.s. of a 5% ethereal solution of an alkylpolysiloxane resin with a R/Si ratio of about 1.5 to obtain a thick homogeneous mixture, which is then dried in a mold at a given temperature (about 40°C).

A second possible composition of active element 31 includes:

0.125 moles of $NiSO_4 \bullet 5.6D_2O$;
0.278 moles of $CuSO_4 \bullet 4D_2O$;
1.853 moles of $Li_2SO_4 \bullet 0.8D_2O$;
0.172 moles of K_2SO_4; and
q.s. of a 5% ethereal solution of an alkylpolysiloxane resin with a R/Si ratio of about 1.5 to obtain a thick homogeneous mixture, which is then dried in a mold at a given temperature (about 40°C).

A third possible composition of active element 31 includes:

0.278 moles of $CuSO_4 \bullet 4D_2O$;
1.853 moles of $Li_2SO_4 \bullet 0.8D_2O$;
0.172 moles of K_2SO_4;
0.125 moles of $TiOSO_4$; and
q.s. of a 5% ethereal solution of an alkylpolysiloxane resin with a R/Si ratio of about 1.5 to obtain a thick homogeneous mixture, which is then dried in a mold at a given temperature (about 40°C).

The quantity of heavy water (D_2O) to recrystallize metal salts $CuSO_4$, Li_2SO_4, and $NiSO_4$ is 20% less than the stoichiometrically calculated quantity, to reduce the activation time of target 5.

With reference to Figure 1, machine 1 also comprises a device 33 (*e.g.* a thermocouple) for measuring the temperature of target 5, a device 34 for detecting and counting the neutrons emitted, and a device 35 for measuring gamma ray emissions, all of which are located close to reaction chamber 2; a device 36 for measuring the pressure inside reaction chamber 2, and which is branch connected to conduit 8 between reaction chamber 2 and valve 29; and a device 37 for detecting the presence of tritium in reaction chamber 2, and which is located along conduit 8 downstream from pumping assembly 4.

Devices 33, 34, 35, 36, 37 are all known types and therefore require no description.

Operation of machine 1 will now be described assuming pumps 28 of pumping assembly 4 have already brought the pressure inside reaction chamber 2 to extremely low values (a few thousandths of a mm of Hg).

In actual use, when valve 17 is opened, the gaseous deuterium flows into conduit 7 and through pressure reducing device 18 into ionizing unit 16, where it is ionized to supply reaction chamber 2 with a flux of deuterons. More specifically, the gaseous deuterium is ionized by electromagnetic excitation by the high-frequency magnetic field produced by device 21, and is conveyed towards reaction chamber 2 by the electric field generated by the two electrodes 25, between which a difference in electric potential of a few kilovolts is maintained.

At the same time, source 11 maintains a difference in electric potential of preferably, but not necessarily, 2 to 10 kilovolts between electrode 12 and target 5, so that the deuterons, once inside reaction chamber 2, are conveyed towards target 5 by the electric field in reaction chamber 2, to bombard target 5 as shown in

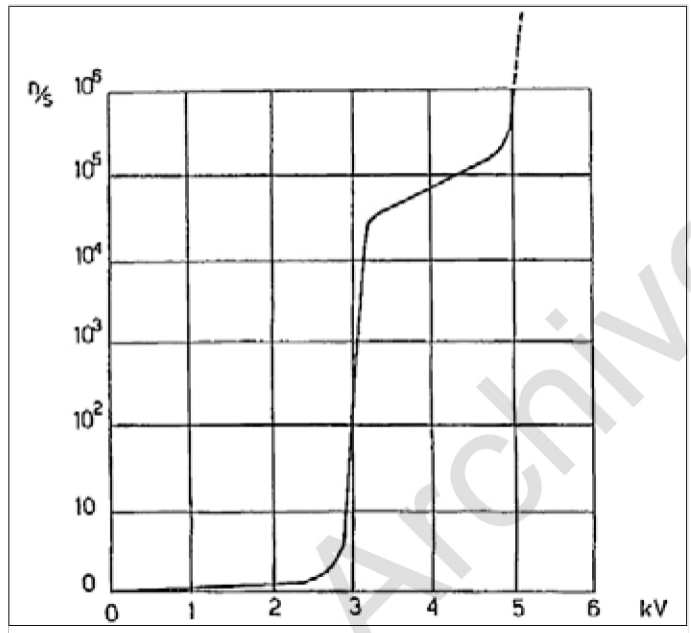

Figure 3. The production of neutrons per second as a function of the accelerator voltage applied.

the Figure 3 graph, which shows the production of neutrons per second as a function of the acceleration voltage applied.

Prior to bombarding target 5, the flux of deuterons is fed through focusing device 13, by which it is concentrated into a narrow deuteron beam suitable for striking active element 31.

Upon the deuteron beam striking active element 31, device 33 detects a fall in the temperature of target 5, and device 36 a fall in the pressure inside reaction chamber 2; which phenomena may be explained by absorption of the incident deuterons into active element 31, and by subsequent catalytic disintegration of the deuterons inside the crystal lattice of active element 31 according to endothermic nuclear reaction:

$$D \xrightarrow{Metal} n + p \ (-2.224\ MeV)$$

where "D" indicates a deuterium atom, "n" a neutron, and "p" a proton.

Subsequently, device 33 detects a sharp increase in the temperature of target 5 (to about 1000°C), while devices 34, 35, 37, respectively, detect a neutron flux (up to 10^5 neutrons per second) several magnitude order (from 3 to 5) greater than the natural flux, a high emission of electromagnetic waves of various wavelengths including gamma and X-rays, and the production of tritium; which phenomena may be explained by the initiation of low-temperature nuclear fusion reactions according to the following exothermic reactions:

(I) $D + D \rightarrow T + p + \gamma \ (+4.015\ MeV)$
(II) $D + D \rightarrow {}^3He + n + \gamma \ (+3.250\ MeV)$

where "D" indicates a deuterium atom, "T" a tritium atom, "^{3}He" a helium-3 atom, "n" a neutron, "p" a proton, and "γ" the emission of gamma rays.

More specifically, exothermic reaction (I) may be the result of the following sum of reactions:

$$D \xrightarrow{Metal} n + p \ (-2.224\ MeV) +$$
$$D + n \rightarrow T + \gamma \ (+6.239\ MeV) =$$
$$\overline{D + D \rightarrow T + p + \gamma \ (+4.015\ MeV);}$$

and exothermic reaction (II) the result of the following sum of reactions:

$$D \xrightarrow{Metal} n + p \ (-2.224\ MeV) +$$
$$D + p \rightarrow {}^3He + \gamma \ (+5.474\ MeV) =$$
$$\overline{D + D \rightarrow {}^3He + n + \gamma \ (+3.250\ MeV).}$$

As exothermic reaction (I) involves the production of tritium, a further low-temperature nuclear fusion reaction may be initiated according to the following exothermic reaction:

(III) $D + T \rightarrow {}^4He + n \ (+17.6\ MeV)$,

where "D" indicates a deuterium atom, "T" a tritium atom, "^{4}He" a helium-4 atom, and "n" a neutron.

In view of the large amount of energy produced, exothermic reaction (III) may account for the sharp increase in the temperature of target 5 (during experiments, target 5 reached temperatures of around 1000°C).

Given the heterogeneous composition of active element 31, other low-temperature nuclear fusion reactions may also take place, such as:

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Deuterium+Deuterium	→	Helium-4
Deuterium+proton	→	Helium-3+gamma photon
Deuterium+neutron	→	Tritium+gamma photon
Lithium-6+neutron	→	Tritium+Helium-4
Lithium-7+neutron	→	Tritium+Helium-4 neutron
Lithium-7+proton	→	Beryllium+gamma photon
Copper+gamma photon	→	Radioactive copper+neutron
Titanium+neutron	→	Radioactive titanium+gamma photon
Potassium+neutron	→	Radioactive potassium+2 neutrons
Beryllium-9+proton	→	Beryllium-8+deuteron

During operation, experiments showed that a reduction in the electric potential difference between electrode 12 and target 5 immediately following the rapid increase in temperature, assimilable with commencement of the nuclear fusion reactions, does not result in a proportional reduction in neutron flux (a reduction in potential from 5 to 3 kilovolts resulted in a roughly 25% reduction in the number of neutrons emitted per unit time).

The method according to the present invention therefore comprises feeding a flux of positive deuterium ions to a reaction chamber 2 housing a target 5 having deuterium atoms in its crystal lattice. Subsequently, the method provides for conveying the flux of positive deuterium ions entering reaction chamber 2 towards target 5, so that the flux of positive deuterium ions strikes target 5 to produce nuclear fusion reactions between the incident positive deuterium ions and some of the atoms constituting target 5.

More specifically, the step of conveying the positive deuterium ions towards target 5 comprises accelerating the flux of positive deuterium ions by means of an electric field, and focusing the flux of positive deuterium ions into a concentrated beam prior to impact with target 5.

In the example shown, the step of feeding the flux of positive deuterium ions to reaction chamber 2 comprises drawing deuterium atoms in gaseous form from tank 15, and subsequently ionizing the deuterium atoms to produce the flux of positive deuterium ions for supply to reaction chamber 2.

Clearly, changes may be made to the method and machine 1 as described and illustrated herein without, however, departing from the scope of the present invention.

Table 1.

International Search Report

International Application No.	PCT/IB98/00388
Classification of Subject Matter	IPC 6 G21B1/00 H05H1/22 H05H6/00
Fields Searched	IPC 6 G21B H05H

Documents Considered to be Relevant

Category	Citation of document, with indication, where appropriate, of the relevant passage	Relevant to Claim No.
X	BACON, F.M. et al: "Intense neutron source development for use in cancer therapy" 1980 CONFERENCE ON THE APPLICATION OF ACCELERATORS IN RESEARCH AND INDUSTRY, DENTON, TX, USA, 3-5 NOV. 1980, Vol. ns 28, no. 2, ISSN 0018-9499, IEEE TRANSACTIONS ON NUCLEAR SCIENCE, APRIL 1981, USA, pages 1902-1905, XP0002052288	1-3, 5, 6, 8
Y	see page 1902, paragraph 1 - page 1903, right hand column, paragraph 2; figure 1	4, 16
Y	PATENT ABSTRACTS OF JAPAN vol. 015, no. 084 (P-1171), 26 February 1991 & JP 02298891 A (SEIKO EPSON CORP), 11 December 1990	4, 16
A	see abstract	1, 2, 5, 6
X	KITAMURA, A. et al: "In situ elastic recoil detection analysis of hydrogen isotopes during deuterium implantation into metals," FUSION TECHNOLOGY, MAY 1996, ANS, USA, vol. 29, no. 3, ISSN 0748-1896, pages 372-378, XP002052289 see page 372, right-hand column, paragraph 3 - page 373, right-hand column, last paragraph' figure 1	1-3, 5, 6, 8
A	MOO, S.P. et al: "An investigation of the ion beam of a plasma focus using a metal obstacle and deuterated target," IEEE TRANSACTIONS ON PLASMA SCIENCE, JUNE 1991, USA, vol. 19, no. 3, ISSN 0093-3813, pages 515-519, XP002052290 see page 515, left-hand column, paragraph 3, see page 515, right-hand column, paragraph 2, figure 1	9,10
A	FALLAVIER, M.: "SEARCH FOR NUCLEAR FUSION IN DEUTERATED TARGETS UNDER CLUSTER BEAM IMPACT" PHYSICAL REVIEW LETTERS, vol. 65, no. 5, 30 July 1990, pages 621-624, XP000206161 see page 621, paragraph 1 - page 622, paragraph 3	1-3, 5, 6, 8
A	EP 0 338 619 A (MODERN; PHILIPS NV (NL)) 28 October 1989 see column 4, line 30 - line 51	11, 15

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0338619 A	28-10-1989	HR 2630251 A	20-10-1989
		DE 68923476 D	24-08-1995
		DE 68923476 T	14-03-1996
		JP 1312500 A	18-12-1989
		US 4935194 A	19-06-1990

Special Categories of Cited Documents

A	Document defining the general state of the art which is not considered to be of particular relevance
X	Document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone.
Y	Document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

Date of the actual completion of the International search	9 July 1998
Date of mailing of the International search report	15 July 1998
Name and mailing address of the ISA	European Patent Office, P.B. 5818 Patentlaan 2, NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl Fax: (+31-70) 340-3016
Authorized officer	Capostagno, L.

Claims

1) A method of producing energy by nuclear fusion reactions, and comprising the steps of:

—feeding a flux of positive deuterium ions to a reaction chamber 2 containing a target 5 having deuterium atoms in its crystal lattice and active metal elements; and

—conveying, inside the reaction chamber 2, said flux of positive deuterium ions towards the target 5, so that the flux of positive deuterium ions strikes the target 5 to produce nuclear fusion reactions between the incident positive deuterium ions and some of the atoms constituting the target 5 itself.

2) A method as claimed in Claim 1, wherein said step of conveying the positive deuterium ions towards the target 5 comprises accelerating said flux of positive deuterium ions by means of an electric field.

3) A method as claimed in Claim 1 and/or 2, wherein said step of conveying the positive deuterium ions towards the target 5 comprises focusing the flux of positive deuterium ions into a concentrated beam prior to impact with the target 5.

4) A method as claimed in any one of the foregoing Claims, wherein said step of feeding the flux of positive deuterium ions to the reaction chamber 2 comprises drawing deuterium atoms from a tank 15, and subsequently ionizing said deuterium atoms to produce said flux of positive deuterium ions.

5) A machine 1 for producing energy by nuclear fusion reactions, characterized by comprising a reaction chamber 2; a target 5 housed inside said reaction chamber 2; a positive deuterium ion source 3 communicating with said reaction chamber 2; and a pumping assembly 4 communicating with said reaction chamber 2 to maintain a vacuum inside the reaction chamber 2; said target 5 having deuterium atoms in its crystal lattice; and said positive deuterium ion source 3 feeding a flux of positive deuterium ions into the reaction chamber 2, so that said flux of positive deuterium ions strikes all the elements of the target 5 to produce low-temperature nuclear fusion reactions between the incident positive deuterium ions and the atoms constituting the target 5 itself.

6) A machine as claimed in Claim 5, characterized in that said reaction chamber 2 comprises accelerating means 10 for conveying said flux of positive deuterium ions against said target 5 and accelerating the positive deuterium ions.

7) A machine as claimed in Claim 6, characterized in that said accelerating means 10 comprise at least two electrodes (5, 12) housed inside the reaction chamber 2; and an electric energy source 11 for maintaining an in any way variable difference in electric potential between the two electrodes (5, 12); one of said two electrodes (5, 12) being defined by said target 5.

8) A machine as claimed in any one of the foregoing Claims from 5 to 7, characterized in that said reaction chamber 2 comprises a focusing device 13 through which said flux of positive deuterium ions travels prior to striking said target 5; said focusing device 13 focusing said flux of positive deuterium ions to form a concentrated beam of positive deuterium ions.

9) A machine as claimed in any one of the foregoing Claims from 5 to 8, characterized in that said target 5 comprises an outer casing 30, which is substantially cup-shaped with a cavity 30a facing said focusing device 13; and an active element 31 housed inside said outer casing 30, and which is substantially cup-shaped with a cavity 31a facing said focusing device 13; said active element 31 being struck by said concentrated beam of positive deuterium ions.

10) A machine as claimed in Claim 9, characterized in that said outer casing 30 is made of metal material.

11) A machine as claimed in Claim 10, characterized in that said outer casing 30 is defined by a stack of alternating washers 32 made of different metal materials and held together by gripping means.

12) A machine as claimed in Claim 9, characterized in that said active element 31 is defined by an aggregate comprising metal salts.

13) A machine as claimed in Claim 12, characterized in that some of the metal salts belong to the class of sulfates comprising ferrous sulfate, nickel sulfate, titanium sulfate, and potassium sulfate.

14) A machine as claimed in Claim 12, characterized in that the metal salts are selected from copper sulfate and lithium sulfate; said sulfate being hydrated with heavy water.

15) A machine as claimed in Claim 9, characterized in that said active element 31 absorbs the incident positive deuterium ions according to an endothermic catalytic disintegration reaction.

16) A machine as claimed in Claim 5 characterized in that said positive deuterium ion source 3 comprises a tank 15 containing deuterium atoms in gaseous form for supply to said reaction chamber 2; and an ionizing unit 16 interposed between said tank 15 and said reaction chamber 2 to so ionize the deuterium atoms as to supply said reaction chamber 2 with a flux of positive deuterium ions.

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Aspden—From page 13

tests. His gold ball was not an ionized plasma. Its atoms were performing as Eddington had presumed, the positive and negative charges being bound together. There could be no gravitational displacement of electric charge in that gold ball and so no electrical and no magnetic action linked to gravity could be expected. Not surprisingly, these events in the six or so years following World War II were of little relevance alongside the interest in atomic power and the promise of hot fusion reactors that could replicate the solar heat source was in command. Blackett's gold ball experiment was duly reported in 1952, the year in which the first hydrogen bomb was detonated.

So, nearly half a century on, we struggle in search of the truth as to the Sun's power source and I say that the Schuster-Wilson theme needs to be revived so that we can deploy resources away from hot fusion research at very high temperatures and look more at the promise of alternative energy sources, including an alternative and more realistic interpretation as to the source of energy which feeds the Sun. Maybe the Boscoli process will prove itself as a viable energy source, even accounting for the nuclear chemistry of the stars, but I think the future will offer us a few surprises on this front.

A task ahead is to stir uncertainty in the establishment concerned with nuclear research funding. Are they wasting money by taking us in the wrong direction? Why have the members of that establishment not seen for themselves the flaw in Eddington's logic? The Sun is not a hot nuclear reactor running at a temperature of tens of millions of degrees. Even a college student can challenge his teachers on this issue and, to this end, I am pleased to report that the Institute of Physics in the U.K. has published, after appropriate referee scrutiny, a contribution of mine in their journal *Physics Education* (p. 263 of volume 34, September 1999). It is entitled "The Imaginary Sun?" and presents, quite simply and in much the same way, the point I make above about the threshold limit of the Sun's mass density. I realize that there is much that can be debated on this issue, particularly where evidence points to the existence of very dense stars, but it seems to me that if cosmologists can go so far adrift in their close-up study of our own nearby star, the Sun, then there is scope for their having made other errors in interpreting what lies well outside our solar system. At least, with *Infinite Energy* we have a chance to share and broaden our base of knowledge concerning the mysteries of the energy underworld.

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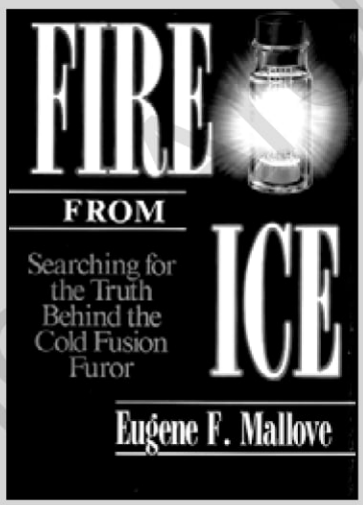

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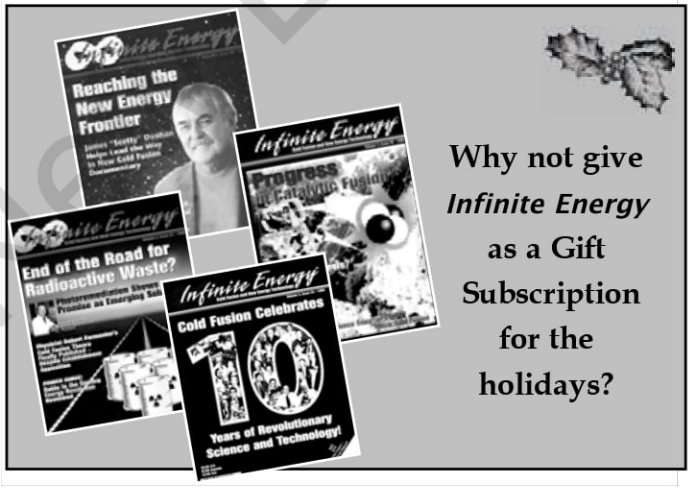

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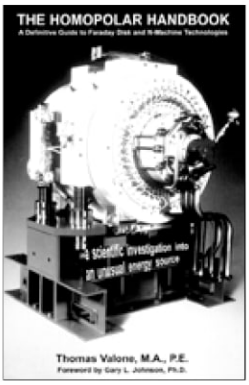

A Visit to Hokkaido University

Report by Jed Rothwell

I visited Hokkaido National University in Sapporo for four days, from June 11 through June 14, 1999. Three groups there are working on glow discharge cold fusion and related experiments:

- Electrochemist Tadahiko Mizuno; Tadashi Akimoto, who specializes in high energy particle detection; Tomoki Katagiri, a fourth year engineering student who is learning to operate the quadrupole mass spectrometer in Mizuno's lab, and Tomako Kawasaki, Mizuno's assistant. Mizuno and Akimoto are working on a new paper which I am translating. We hope to publish the entire paper when they finish it. Mizuno has been assisting others to replicate the glow discharge experiments. Dr. Xing-Zhe Zhao of the Kansai Research Institute (KRI) reports that he succeeded, observing as much as 300% excess heat (three times input). Mizuno has sent several prepared tungsten cathodes to Scott Little, of EarthTech International, but Little has so far not seen the excess heat effect, either with Mizuno's cathodes or with cathodes fabricated from locally available materials.
- Tadayoshi Ohmori is conducting his own experiments and collaborating with Mizuno. We published their paper in the last issue.[1]
- Kazuhisa Azumi, Masahiro Seo, and Mizuno are studying the conventional electrochemical behavior of glow discharge systems. They have not looked for excess heat in the reactions. They recently published a paper in the *Japanese Electrochemical Society Journal*, which is described below.

Mizuno's Recent Work

Mizuno spent several months running 100 experiments, each lasting 1000 seconds (16 minutes). He varied current density and temperature with each run, and plotted the energy release as a single data point. He found that tungsten does not produce excess heat at current density below 0.8 amps per cm^2 or above 1.5 amps per cm^2. Tungsten cathodes do not usually produce significant excess heat below 80°C, and the heat increases rapidly as the cell approaches 100°C. Even within the critical ranges of current density and temperature, some cathodes do not produce heat. Current density and temperature are necessary but not sufficient parameters. Some other unknown factor or factors affect the heat.

After electrolysis, cathodes were washed with pure water, dried, immersed in analytical grade acetone, and placed in an ultrasonic cleaner for ten minutes. This treatment removed deposits galvanized onto the cathode surface along with a thin layer of cathode metal. An EDX spectrometer revealed formations of new elements extending below the remaining surface layers. Different new elements were found depending on the elements originally present. The mass and distribution of the anomalous elements depended upon the electrochemical treatment, the type of electrolyte and other parameters. However, in every case in which excess heat was generated, Si, Ca, Ti, Cr, Mn, Fe, Cu, and Zn were observed. When ordinary, non-glow discharge electrolysis was performed for 1000 seconds on other samples, or when glow discharge did not produce excess heat, no new elements were found inside the cathode.

> *If I had several lifetimes, I could reinvent most of the techniques for purifying, cleaning, assembling and testing cells, wrapping and trimming wires, spot-welding, and so on. Anyone handy with tools could do it. But to get the job done in one lifetime you must learn from experts.*

The EDX analysis shows elements, not isotopes. Mizuno has not been able to investigate the isotopic distribution of the new elements yet, because they appear in small, widely scattered groups, which are difficult to find with his SIMS spectrometer. A SIMS reveals only one tiny spot on the surface at a time. He wants to try some other instrument that tests the entire sample at once.

These 1000-second tests were performed with the equipment configured as a static (isoperibolic) calorimeter. This type of calorimeter depends upon calibrations. A quartz glass cell is filled with water or electrolyte and an electric joule heater is placed inside it at the same spot the anode and cathode will later occupy. A magnetic stirrer is placed on the bottom of the cell. The cell is placed inside an incubator (Yamato 1L-6) which is a small refrigerator-like box with circulating constant temperature air, at 23 +/- 0.1°C. The joule heater is turned on, and the power is held at one level until the fluid temperature stabilizes and remains constant for several hours. The average stable value constitutes one calibration point. Power is increased to another level and another point is established. With a properly designed cell, the points line up in a linear calibration curve. After calibration, the cell is washed and filled with fresh electrolyte. The anode and cathode assembly are installed and glow discharge electrolysis is performed. The cell temperature is compared to the calibration curve to determine how much power the reaction produces. Energy lost to water vapor and effluent hydrogen and oxygen gas must be taken into account. Water vapor from the cell is cooled and condensed externally, and later measured. Vapor and gas lost from the cell can be estimated by weighing the cell before and after the run on a milligram scale, but this method is not very accurate, because very little gas is lost.

After performing the 1000-second tests, Mizuno rearranged the equipment to make a flow calorimeter. A quartz glass cell with a double wall was used. Pure cooling water from a constant temperature bath was pumped through the space between the inner and outer wall. The difference between the inlet and outlet temperature indicates how much heat is produced in the cell. This method does not depend upon electrolyte temperature. (By coincidence, Edmund Storms also recently began using double walled cells for flow calorimetry.) A reflux condenser returned evaporating water to the cell. Because the cell was not well-insulated and heat from the condenser was not captured, heat recovery was low, only 87 to 89% during calibration, but it was consistent. When 97 to 102% heat was later recovered, it is safe to conclude that significant excess heat was being generated, even though the recovered energy was almost equal to input energy. The flow configuration is handy for holding the cell in a stable state by adjusting the flow rate.

The first experiments reported by Mizuno at ICCF-7 were performed with poorly-insulated cells using heat release calorimetry. With this method, you measure a one-time change in the temperature of the thermal mass, that is, the mass times specific heat of the electrolyte fluid and the vessel glass. The fluid is mostly water and the specific heat can be taken as that of water. The specific heat of quartz glass or Pyrex glass is one-fifth that of water. The mass and specific heat of the metal electrodes and other parts is negligible, and need not be taken into account.

With an ideal, perfectly insulated adiabatic cell holding 100 grams of water, 100 calories of electrical energy would heat the water by 1°C. (No real cell can be perfectly insulated.) With the

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poorly insulated quartz glass cells used in Mizuno's initial experiments, and still used today by Ohmori, much of the energy quickly escapes as radiation from the cell walls, so the water heats a fraction of 1°C. To determine how much heat was escaping, Mizuno and Ohmori measured the heat decay curve after power was turned off. Starting in July 1999, Mizuno began using heat release calorimetry with a well-insulated cell made of a Pyrex vessel fitted into a Styrofoam shell, filled with 1 kg of electrolyte. At low temperatures, the performance of this cell approaches that of a perfectly insulated cell which simplifies computation of the heat balance. At high temperatures heat losses become significant and must be taken into account.

The insulated heat release calorimeter is accurate and easy to understand based on first principles. During calibration runs the energy balance repeatedly came out close to unity, with values like 99.990% and 100.008% output as a percent of input. Zhao, at the KRI, used an insulated heat release cell (a Dewar) with 2 liters of water. In September he visited Mizuno and brought a 4 liter Dewar cell. They tested it and observed 140% excess heat for the entire run.

To summarize, Mizuno has now used four methods of calorimetry: uninsulated heat release, static, flow, and insulated heat release. Two of these methods have been successfully used by Ohmori and Zhao. The more methods you use to measure a phenomenon, the more confidence you have that it is real. The weaknesses of one method are canceled out by the strengths of another. Heat release experiments can only last a short time until the water reaches boiling, whereas static or flow experiments can continue indefinitely. Heat release and static cells might be affected by transient changes in the insulating qualities of the fluid in the cell, whereas flow calorimeters are immune to this problem.

All four calorimeter types employed until now suffered from an important limitation: they cannot reach temperatures above the boiling point of water. The data indicates that the reaction efficiency increases swiftly above 80°C, climbing exponentially as the cell approaches boiling. We do not know what happens after this because the cells are run at atmospheric pressure so the temperature never goes above 100°C. To overcome this limitation, Mizuno and the Santsuri Company are building a heavy, stainless steel, pressurized cell.

Why the excess heat reaction efficiency increases at temperatures above 80°C is an interesting mystery. The glow discharge reaction itself occurs at 2000 to 3000°C. It is hard to imagine why a relatively tiny change in water temperature, from 20°(room temperature) to 80° (hot coffee) could affect a 3000° plasma (half the temperature of the Sun's photosphere). Mizuno believes that the water temperature probably affects ordinary electrochemical reactions that occur outside of the glow discharge, perhaps at the anode, and these ordinary electrochemical reactions promote the mysterious glow discharge excess heat reaction.

Trying to Learn Why Replications Have Failed

I made this trip to learn the latest news about Mizuno's work, to work on the translation of the new paper, and to try to determine why our group (NERL) and Scott Little did not observe excess heat in our replication attempts. We still do not know why, but I did learn some things about the experiment that were not described in the papers. We have some new ideas and approaches to try, but there does not appear to be a missing step or a secret that Mizuno forgot to tell us.

If the excess heat is real, Mizuno must be using better materials and techniques, even though Little has strived to make the experiment as similar as possible. Mizuno examined Little's website reports and photos describing the replication[2] but he did not spot any important differences. If the heat is an artifact, there must be something wrong with Mizuno and Ohmori's calorimeters. This seems unlikely because they have successfully used different types of calorimeters and a variety of temperature sensors including grounded, compensated thermocouples, and mercury thermometers. Since I have not visited Little's laboratory, I cannot pinpoint the detailed differences between the experiments, but I can help by gathering information and forwarding it to Little. I sent him raw data from recent experimental runs with two types of calorimeters, two papers (one is published),[3] a recent paper by Sengupta[4] about the glow discharge effect (described below), more than 150 electronic photographs of equipment, and two hours of video showing Mizuno performing the experiment and Mizuno and Ohmori discussing it. Little is studying this material. Even if he finds few new ideas to try out, it will be good preparation should he later decide to visit Mizuno himself. Acting on a suggestion made by Ed Wall, Little mailed five cathodes, including a used one, back to Mizuno. Mizuno is analyzing the cathode with his microscopes and mass spectrometers. He may find surface contamination or some other problem with the metal. Later, he plans to subject the cathodes to glow discharge electrolysis in his own calorimeter to see whether he can produce excess heat. Little fabricates his cathodes by TIG welding the tungsten foil to the tungsten lead wire, whereas Mizuno uses spot-welding. Perhaps this makes a difference which can be detected with the instruments.

The only firm conclusion we can reach today is that if there is a difference between Mizuno's experiment and Scott Little's, it must be subtle. It is probably related to surface preparation. What seems like an inconsequential difference might cause a large problem, the way a temperature of about 75°C will make a soufflé fall flat. To take a less homely example from a recent *Scientific American* article about materials: . . . it is not understood why three atoms of hydrogen per million atoms of iron can make normally ductile steel dangerously brittle.[5]

You should not expect revelations during a visit unless you come unprepared. I did my homework; I knew what I would be seeing, so I devoted most of the time to discussing nitty-gritty details. I learned two things about material preparation which were not explained in the papers and which may be important: 1) A cathode should be prepared by scoring the surface, that is, by scratching the surface with glass. 2) A cathode should be electrochemically aged. It is not clear whether scoring and aging are crucial to success, but they do appear to enhance the effect. Little has not yet had a chance to try these techniques.

Aging means subjecting the cathode to electrolysis in order to condition the metal. Ohmori ages a new cathode for at least one hour at 17 to 18 volts, 2.0 to 2.3 amperes. This is vigorous electrolysis, but it is not powerful enough to cause a glow discharge. Ohmori formerly aged cathodes for at least twenty-four hours, but lately he has come to believe that an hour is long enough. Mizuno ages by performing glow discharge electrolysis for about a half-hour at voltages too low for excess heat.

Ohmori seems more methodical than Mizuno, and he has achieved more consistent excess heat. He always performs scoring and aging. Mizuno scored the cathodes during the 100 test runs, but in his later tests with flow calorimetry during June 1999, he did not bother to score the cathodes. These tests produced marginal excess, which is anecdotal evidence that scoring is important. But he did not perform systematic comparisons of scored and unscored cathodes. Ohmori's cathodes look more elegant than Mizuno's. The tungsten lead wire is spot welded close to the edge of the foil, whereas Mizuno's lead wire protrudes halfway down one side of the foil. Ohmori's spot weld seems stronger. When he scored the surface of a cathode, he held it in position by pressing down on the lead wire. With Mizuno's cathode, the spot weld holding the lead wire to the cathode is fragile and it would break if you tried this.

How to Scratch a Cathode

We discussed this topic at length while we ate an elegant lunch in a sparkling new restaurant on campus. (Finding an elegant restaurant on the campus of a Japanese National University was the biggest surprise of this trip. It is like finding a gourmet sushi stand in a U.S. baseball stadium.) After lunch, I took several minutes of video footage of Mizuno and Ohmori demonstrating their respective techniques for scoring cathodes. Ohmori thinks this step is quite important because he believes the effect occurs at microscopic dislocations and uneven surfaces formed along the scratches. Microphotos show melting and apparent transmuta-

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tions at the dislocations. Mizuno is not as sure that scoring is important. I asked both researchers why they have not done a careful comparison between scored and non-scored cathodes. Mizuno replied that he is busy looking at other parameters such as temperature and current density. Ohmori said he is convinced that scoring is essential and he does not have time to run a series of tests to prove it, because the problem space is so large and there are so many other areas to explore. It would take a large team of researchers many weeks to settle this issue. Clearly scoring is not essential; some smooth cathodes do produce heat, but it appears to enhance the reaction. If it is done wrong and the cathode surface is contaminated, it might prevent the reaction.

It is not easy to scratch tungsten, which is one of the hardest metals. To score a cathode you start by making glass shards. Here is Ohmori's method:

- Place a clean Pyrex vessel in a plastic bag (Mizuno uses quartz glass).
- Smash it with a hammer.
- Clean the shards in warm aqua regia for ten minutes.
- Wash thoroughly in Milli-Q water, from a Millipore Milli-Q Labo water purifying machine.

After you have prepared the glass, you keep it in a test tube covered with plastic wrap. When it is time to prepare a cathode:

- Sandwich the cathode in sheets of copier paper to keep it reasonably clean, and hold it down, with your finger on the lead wire. Do not touch the cathode surface.
- Pick up a glass shard and hold it carefully, to avoid cuts and to avoid touching the cathode with the part of the glass your fingers touch.
- Scrape each side 100 to 200 times, in a crosshatch pattern.
- Wash the cathode in ultrapure Milli-Q water after scoring. Ohmori does not perform any other cleaning at this stage. He thinks that acetone or an ultrasonic bath will wear down sharp protrusions and uneven surface areas, which defeats the purpose. The cathode is quite clean when he begins, and it still appears clean after electrolysis.

How Clean Must It Be?

Mizuno thinks glow discharge should be easier to replicate than other forms of cold fusion. We were anxious to perform an exact duplicate of his experiment. In e-mail exchanges and discussions, we asked him to describe the precise geometry of the anode and cathode, the steps he takes to ensure cleanliness, and other nitty-gritty details. It turns out he is cavalier about anode-cathode geometry, which surprises me, because electrochemists often make a big fuss about this. Mizuno and Ohmori both use a large, round, platinum gauze mesh anode and they position the cathode above or below the mesh, so that it does not come too close and short circuit, or melt, the platinum with the intense heat of the glow discharge. (The platinum anode costs $600 to $1000, so it must be protected and reused. The tungsten cathode is destroyed after an hour or two of use.)

We asked Mizuno whether he thinks it is necessary to use the ultrapure Milli-Q water, and whether we need to take the elaborate precautions that electrochemists habitually take when preparing electrolyte and cathodes. He assured us these preparations are not necessary. Distilled water from a drugstore should be as good as Milli-Q water. That is what he thinks, but he has never used water from a drugstore, and he has never done the experiment without the elaborate precautions, so he does not know.

The experiment often fails even when Mizuno does it. Paradoxically, this is a reason to be cheerful. It means the experiment is inherently difficult so we should not expect instant, consistent success. It means the effect is probably not an artifact. A temperature artifact would be more regular; it would show up every time under the same conditions, and it would not fluctuate.

Trying to understand the experiment without seeing it firsthand was difficult for us because Mizuno kept changing the instrument configuration. He would mail a schematic and then a few weeks later tell me, By the way, I'm not using that kind of condenser any more; it was too much trouble. The 1000-second tests were all performed with the same configuration. He used scored cathodes which he rigorously prepared wearing gloves and other means to ensure cleanliness. But before and after these tests, he often changed the calorimeter configuration. An experiment is not a museum exhibit. A researcher should tweak his instruments and try new configurations. Using four different calorimeters to detect excess heat is an excellent idea. I am glad that Mizuno is willing to take bold steps and make major changes, but it does make it difficult to follow what he is doing.

A Checklist of Problems and Questions

One of my goals on this trip was to resolve a checklist of issues and questions raised by other people. For example, Scott Little and others worried that the copious radio frequency (RF) noise generated by the glow discharge reaction might affect the thermocouples, creating a false indication of excess heat. Now that I have examined the equipment and looked at many samples of raw data, I conclude this hypothesis is wrong for five reasons:

1. Noise would just as likely cause a false indication of excess cold—an energy deficit. No such indication has been seen.
2. In many runs, thermocouples were replaced or augmented with mercury or alcohol thermometers, which are immune to RF interference. Ohmori said that RF noise was so severe he gave up on thermocouples and used alcohol thermometers exclusively. Mizuno said RF was a problem initially but that his thermowells are well-grounded and the leads are compensated, so it no longer appears to be a problem.
3. The water is pumped from a large constant temperature bath, which has precise control over the bath temperature. The inlet thermocouple agreed closely with the bath temperature. The bath temperature was above ambient and the water traveled three meters to the cell, so it was slightly cooler when it reached the inlet thermocouple. This caused small fluctuations when room temperature changed.
4. In some runs, including the calibration I ran, the electrolyte temperature was measured with a mercury thermometer. The thermocouple agreed closely with the thermometer. The cell came to boil audibly and visibly at the exact moment the thermocouple registered 99°C. Since the inlet and the cell temperature thermocouples were demonstrably correct, it is hard to believe that only the outlet one was wrong.
5. I taped a thermistor to the outside of the outlet tube. It agreed with the outlet thermocouple to within 2 or 3°C. The outlet temperature was 10°C hotter than the inlet, and 15°C warmer than ambient. By the time the water splashed back into the constant temperature bath three meters away, it was several degrees cooler.

David Marett gave a paper during the *Infinite Energy*, Manchester, New Hampshire forum, in which he described a careful replication of this experiment.[6] He saw artifactual excess heat which faded over time. Mizuno and Ohmori tested for the kind of artifact he saw years ago, but let us review his conclusions to complete the record. Marett's main conclusion was that heat was temporarily retained by the cell due to bubble formation, which looked like 142% over unity excess heat after nine minutes. The temperature rose because the cell insulation was temporarily improved, not because more heat was generated. When the cell was run significantly longer than ten minutes, this artifactual heat would dissipate. Since large quantities of bubbles formed during working, the density of the solution changes. This is likely to retain heat in the center of the solution and temporarily cause higher temperature near the center where the thermometer is located. This transient dissipative structure may be responsible for the initial rise and then fall in the rate of heating. Mizuno and Ohmori have now prolonged the reaction as long as eighty-three minutes, and Mizuno has used flow calorimetry, in which electrolyte temperature is not a factor.

The problems listed in Marett's conclusions were:

1) The absence of magnetic stirring introduces non-uniform heating. Both Mizuno and Ohmori added magnetic stirrers two years ago. They recommend stirrers.

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2) Ohmori and Mizuno did not report collecting evaporated solution or solution loss, only temperature rise. This has now been done, although in most cases the experiment is terminated when the temperature reaches 95 to 100°C, when evaporation becomes significant.
3) No one has reported using insulation in their experimental vessels. Ohmori and Mizuno's vessel only retained 26% of the heat generated. . . This means that most of the heat generated during the experiment and control was lost to the outside. This, in conjunction with no stirring, compels me to conclude that there was no excess heat generation. Mizuno and Zhao have now tested well-insulated vessels, and flow calorimetry that recovers 80% of the heat generated. Ohmori continues to use poorly-insulated vessels. However, this point is moot. Although they did not discuss this detail in the early papers, Mizuno, Ohmori, and Zhao measured heat losses by examining the heat decay curve after the experiment. The heat was lost to the outside, but it was not unaccounted for.

Little was worried about the calibration heater which is shown in the calorimeter schematic. He thought it might contaminate the electrolyte even if it is covered with Teflon or some other wrapping. It turns out the calibration heater is never placed in a cell with clean electrolyte or a working cathode. First the cell is calibrated with the heater in water or electrolyte, then the cell is cleaned, fresh electrolyte is added, and the anode-cathode assembly attached to the cell lid is inserted. The schematic shows all components in place, but actually they would not fit at one time. Also, the heater is rusted and dirty, so Mizuno would not think of putting them in together.

I did not try to check off every objection raised by every person. For example, one skeptic insists that the excess heat must be an artifact caused by input electric power being under measured. He feels that the glow discharge reaction must cause large spikes of input power with extremely short durations—so short they are not detected by the power meter. However, Mizuno uses two independent power meters: the data logger (Advantest R7326B) and a digital power meter (Yokogawa WT130). They agree to within 0.1%. If a significant fraction of the power was not detected because of spikes (or for some other reason), the instruments might both be wrong, but they would not be wrong to the same extent. They have different performance specifications. The Yokogawa meter would capture more of the short duration spikes than the Advantest, and it would show higher power.

The video I shot showed aspects of the experiment Scott Little and Ed Wall had not thought about. For example, the cathode lead wire is insulated with heat shrink Teflon tube. The glow discharge covers part of the Teflon, because electricity is conducted to the edge of the Teflon covered metal. Ed Wall wondered why the Teflon did not melt in the intense 2000 to 3000°C temperature. When we did the experiment, the Teflon melted and littered the bottom of the cell, whereas Mizuno's Teflon remained intact. The video shows Mizuno shrink-wrapping it with the flame from a small blowtorch. We did not realize such tough material was available. If we cannot find similar Teflon in the catalogs, we will ask Mizuno for some samples. If we had thought about this we would have realized that heat resistant Teflon must be sold somewhere, but we learned that lesson by watching the video, instead.

Ed Wall wondered about the Pyrex container Mizuno used. In previous experiments with a smaller vessel and less electrolyte, Mizuno used heat resistant (and expensive) quartz glass. In the latest series of experiments with the large, insulated vessel, the anode and cathode are farther away from the vessel walls so heat damage is less likely, so Mizuno felt safe with Pyrex, but he still recommends quartz glass.

When you visit a laboratory, look at equipment, and ask questions, you can clear up many misunderstandings and concerns in a short time. In half an hour you can cover more ground than a week of phone calls and e-mail exchanges. Reading papers is essential, but in the end there is no substitute for seeing and touching equipment, and watching things happen. I wish cold fusion scientists would visit one another and interact more often during conferences. Someday we will have video telephones and Internet connections that will allow us to see what other people are doing at distant locations. This may not be much use in ordinary conversations, but when technicians confer and scientists try to understand what their colleagues are doing, video connections may prove to be invaluable, even with the fourteen-hour time difference between Atlanta and Sapporo.

Neutron Claims Retracted

When Ohmori and Mizuno first reported this experiment at ICCF-7, they said a neutron detector showed a large flux of particles. They reported an even larger number than they meant to, because they mixed up the actual detector count with the extrapolated count for the entire cell, based on the incident area of the detector. Mahadeva Srinivasan and others called these results into question. They said the detector was probably picking up RF noise from the cell. Ohmori and Mizuno admitted they do not know much about detecting neutrons. Eichi Yamaguchi of NTT lent them an excellent neutron detector which they placed above the incubator in Mizuno's lab. This instrument has not detected significant numbers of neutrons. Akimoto, who is an expert in detecting particles, doubts that the experiment is producing neutrons or charged particles.

July 8 Tests

On July 8, 1999, Mizuno did five experiments with a tungsten cathode. The first four produced no excess heat, as expected, because voltage was low. These runs were performed to calibrate, and to age the cathode.

Volts Maximum	Duration Seconds	Average Energy Balance Input/Output ratio	
100 V	1200	1.008	(See Figure 1)
120 V	1200	1.024	
160 V	1200	1.028	
180 V	1200	1.028	
200 V	800	1.103	(See Figures 2, 3)

In the fifth run, average excess was 10%. Bursts of excess heat appeared after voltage was ramped up 400 seconds into the run. The run was cut short after 800 seconds when most of the cathode disintegrated.

The fifth run began at 4:01 p.m. At 4:14 the tungsten cathode largely disintegrated, and input power declined. Mizuno turned off the power, ending the run at 800 seconds. After collecting cooling curve data, Mizuno analyzed the data to see whether anything unusual had happened. He found an apparent burst of excess heat starting around 4:11, lasting 160 seconds. (Data points 550 through 710.) During this event, as the current fell, the cell temperature rose faster than expected from input power alone; 21,803 joules of heat from electricity were added to the cell, and 1,243 joules were lost as radiant heat from the sides and top. The thermal mass was equivalent to 1100 grams of water, so the temperature should have risen 4.5°, yet it rose 6.2°. The extra ~1.7° represents 7,995 joules, or 50 watts of excess power on average.

Data was collected every ten seconds. Figures 1 and 2 show one-minute moving averages, six points averaged together. When data points are not averaged, as shown in Figure 3, output power fluctuates. It even includes negative excursions: an example can be seen at second 650, when the temperature drops from 72.9° to 72.1°C. This translates into 3680 negative joules, energy apparently lost from the cell at the rate of 368 watts. At these temperatures energy cannot leave this cell at such a fast rate. When the cell is brought to boil and power is turned off, heat is lost at the maximum rate of ~27 watts. What caused this sudden temperature fluctuation? I can think of three explanations:

1. Despite the fact that the cell is equipped with a magnetic stirrer which vigorously churns the fluid, at such high temperatures a stream of boiling water might rise from the hot cathode and bypass the temperature sensors. From time to time this stream of hot water may come in contact with the temperature sensor. The problem with this hypothesis is that similar fluctuations did not occur during the calibration runs, when the temperature and operating conditions were nearly identical.

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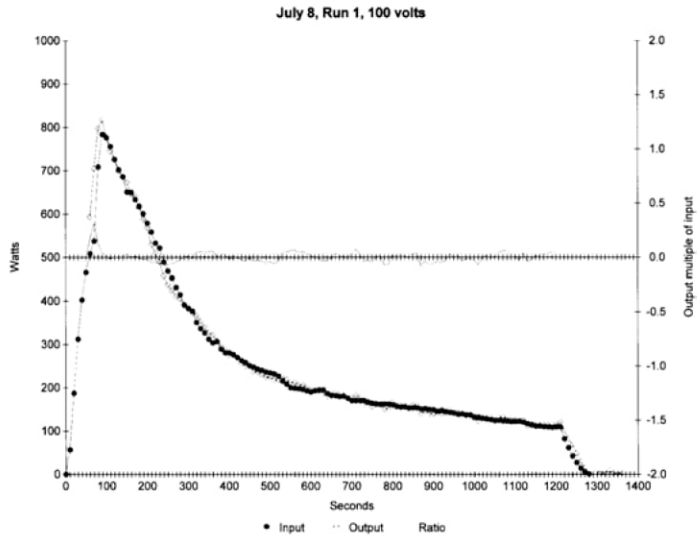

Figure 1.

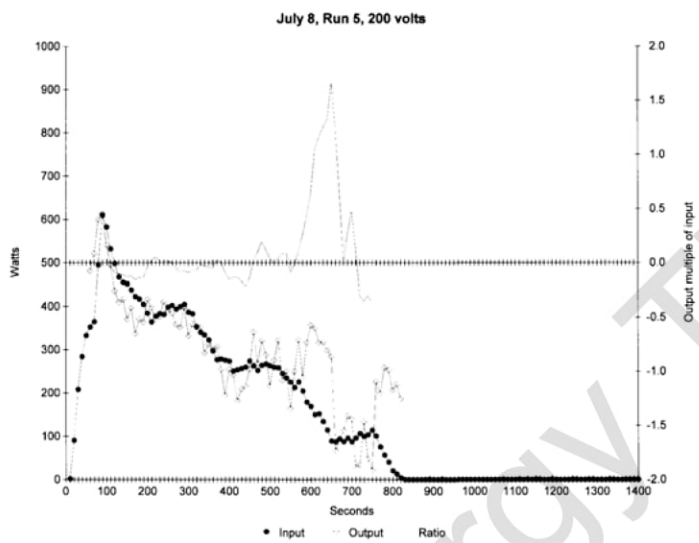

Figure 2.

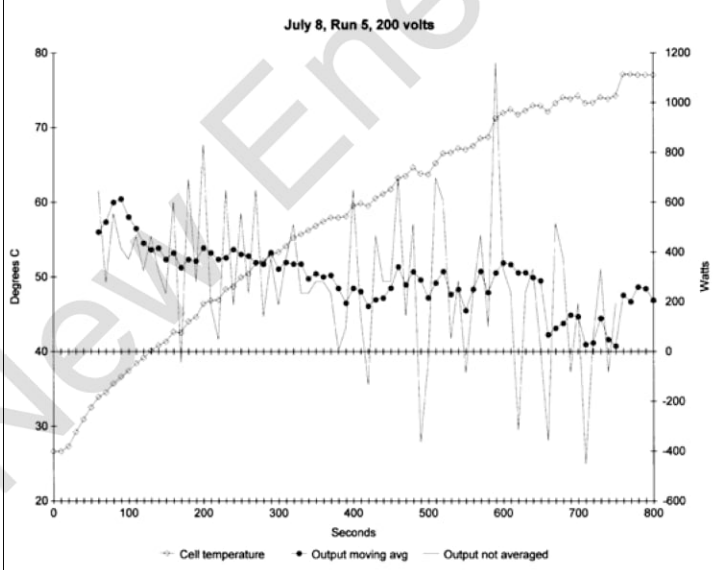

Figure 3.

2. The cathode is generating intense bursts of excess heat. After a burst, it takes a few seconds for the water to mix and the temperature to become homogeneous again. The computer samples the temperature every ten seconds. A burst might occur just before a sample is taken, when a wave of heat is still spreading out from the cathode. A few seconds later the entire mass of water reaches temperature equilibrium and the local temperature around the thermocouple temperature falls back somewhat.

3. Intense RF energy from the glow discharge reaction affects the thermocouple, causing false readings. Mizuno agrees this is happening to some extent, because at the end of the run when the power is turned off, the temperature jumps from 74.2°C up to 77.1°C. Short term fluctuations from one reading to the next cannot be trusted, although overall trends in the moving average are meaningful, because noise will cause both negative and positive jumps which cancel out. However, Mizuno says that the RF noise is known to introduce a slightly negative bias.

RF noise may be a problem, but we can sidestep it by examining the temperatures before the glow discharge began, and after power was turned off. RF noise ceased instantly when the power was turned off. We can disregard all data recorded while the glow discharge occurred. This was the advantage of heat-release calorimetry. The cell temperature began at ambient: 26.6°C. At time 780 after the power was turned off, the temperature reached the peak value of 77.1°C. Total heat evolution was:

(77.1° - 26.6°) x 4.187 joules per calorie x 1100 gram thermal mass + 3421 joules radiant heat losses = 236,008 joules

Input energy was 214,373 joules. Excess energy was 21,635 joules, or ~10% of input. There are only two potential errors with this method:

1) Errors measuring input power. As noted above, this seems unlikely because in some runs Mizuno compared input power measured by the data logger to a recording digital power meter, and he found less than 0.1% difference.

2) Recombination. This figure for input energy is reduced to account for the loss of hydrogen and oxygen gas from electrolysis. It is conceivable, although unlikely, that the effluent gas recombines without leaving the cell. However, only 1.48 volts out of 200 volts go into electrolysis. Complete recombination would add only 900 joules to input power.

Some Informal Impressions: A Day in the Life of a Cold Fusion Researcher

A glow discharge experiment is the most dramatic form of cold fusion, but being in the room while a test is run, you would not guess that anything important is happening. Most of the day is devoted to preparations. A batch of electrolyte is mixed. The anode and cathode have already been cleaned, prepared, and put aside. The anode is stored in acetone. Mizuno retrieves a cathode, scores it, and carries it downstairs to another lab where he spot welds it to a lead wire, with a brief, intense spark and a puff of smoke. Shrink-wrap is applied. Parts of the cell are fitted and repaired. As he works in the cluttered space, Mizuno accidentally knocks a box of plastic wrap off a stack of petri dishes onto the floor. Kawasaki laughs, Stop breaking things! We have enough broken stuff here already. Was that a dish? I ask. No, nothing, she replies, just plastic wrap. Mizuno mutters, Let me at it: I'll break anything. . . . I don't like the looks of this anode . . . He goes downstairs to repair it with the spot welder. Finally, the anode, cathode, and thermocouples, which are attached to the lid of the cell, are installed. A blue Styrofoam shell is placed around the cell and taped together. The cell is placed on the magnetic stirrer inside the incubator. The stirrer is turned on. Is the Teflon coated magnet at the bottom of the cell spinning freely? We listen for the knocking, clattering sound, and we look through the peephole in the blue insulation. We see flashing light reflected from the spinning magnet. We turn off the stirrer, the noise goes away, the light stops flashing. Turn it on again, the noise and light reappear. The stirrer is spinning clear of the thermocou-

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ples and other cell components.

It is slow and patient work. It was often interrupted during my visit by students dropping by to pick up tests or the key to the lab across the hall. The phone rang frequently because Mizuno's work was recently described in *Sentaku* (Choice), a pricey executive newsletter with a large circulation. Corporate laboratory electrochemists called for information, preprints, and advice about materials.

There is no sense of drama during a test. Mizuno turns the power on and stands around watching the meters. He gradually increases the power, minute by minute, as quickly as he can without melting the cathode. He and Kawasaki gossip and complain about the hot weather. Every ten seconds, the computer records the date, time, room temperature, the incubator air temperature, and the cell electrolyte temperature, voltage and current. After glow discharge begins and the final adjustments to the power settings are made, Mizuno and Kawasaki attend to other tasks while the water comes to boil in ten or fifteen minutes. Mizuno turns off the power and waits for the cell to cool, to measure the heat decay curve. It is nearly the same curve with every run, but for maximum accuracy he measures it every time. He does not know whether the cathode produced excess heat until about an hour after the test finishes. He transfers the data from an ancient 5.25 inch diskette on the data collection computer, to a 3.5 inch diskette on another old computer, and finally to the hard drive on a third computer. He loads the ASCII data into a spreadsheet, computes the heat loss and energy balance, and prints color graphs. Mizuno and Kawasaki have done this hundreds of times over the years, and they have seen excess heat more than one hundred times. It is a work-a-day occurrence to them. While watching the blue glow discharge, Mizuno said, I pity anyone who is trying to do this with palladium. It takes so long! It is so much trouble . . . This method brings us directly to a hot, dynamic reaction.

Powerful cold fusion reactions with other metals are also triggered by high temperatures, but with other metals it is not possible to raise the temperature quickly. In 1992, Pons and Fleischmann took anywhere from eighteen hours to several days to fully load a palladium cathode at low current density.[7] When the cathode was loaded it would begin producing low-level heat. They would turn up electrolysis power briefly, in a pulse lasting less than three minutes. This would drive the cathode temperature up to 180° to 200°C, which would trigger high excess heat. The electrolyte would boil off and the cathode would remain hot in a heat after death reaction, which would sometimes last for hours. A heat pulse applied before the cathode was fully loaded would not trigger a boil off or a heat after death event.

Other cold fusion scientists have worked for years trying to achieve excess heat, without success. They would be thrilled to see results like Mizuno's. This test would be high drama in most labs. Scott Little worked unsuccessfully for weeks trying to replicate heat in this experiment. Naturally, he has doubts about Mizuno's calorimetry. This situation is frustrating to everyone, and deeply unsatisfactory, but it is hard to know what we can do about it.

The State Room Scene in A Night at the Opera

I described Mizuno's cramped laboratory in the book *Nuclear Transmutation: The Reality of Cold Fusion* (Infinite Energy Press, 1998). I can report that the University finally did get around to fixing the leak in the roof, but the room remains as crowded as ever. Mizuno removed a large hydrogen purification apparatus, but he is still running three cold fusion experiments and one conventional experiment in corrosion. His assistant, Tomako Kawasaki, occupies a cubbyhole behind the incubator cabinet and shelves, and a third desk has been brought in for Tomoki Katagiri, an undergraduate senior who is operating the quadrupole spectroscope. They have crammed in a small refrigerator; five computers; several equipment racks; pen recorders; an oscilloscope; a huge, deluxe constant temperature water bath remaindered from the NHE project; knickknacks; bric-a-brac; a large, stuffed, talking Pokémon doll; and the inevitable doily-covered table where they serve ice tea and cakes or hot coffee brewed over a Bunsen burner. While Ohmori and I spent a few hours in the afternoon reviewing data over tea and cake, Katagiri dropped by between classes, and someone from administration delivered a stack of papers for Mizuno to sign. It began to look like the stateroom scene in the Marx Brothers' movie A Night at the Opera.

National University buildings are not air conditioned even in the subtropical parts of Japan. Hokkaido normally has a mild summer climate, but this year the temperature was over 30°C outside (86°F), and with the experiment running, heavy power supplies, computers, and other equipment in the room was turned on, adding to the heat. The fans were blowing, the windows were open. The hallways and other labs were quiet. Most of the students were outside enjoying barbecues instead of studying. (Japanese college students know how to take it easy. I have not seen them study hard at any time of the year, but especially not during the last week of classes before summer vacation. They concentrate on cookouts, club activity, and learning how to ride a bicycle while lighting a cigarette and talking on a cell phone—preferably with a girlfriend riding side-saddle on the back. She holds the umbrella when it rains.)

Japan is a crowded country, and National University facilities are Spartan. The hallways are filled with clutter, broken equipment, trash, ashtrays, and barbecue grills. The buildings are falling apart. It is a friendly, relaxed atmosphere, conducive to learning. It is not conducive to electrochemistry, which requires cleanliness and space to work.

There is plenty of space available on campus; Hokkaido is the most spacious of the National Universities, but the other professors do not like this research. They asked Ohmori to move his experiment out of the regular lab and into a small room behind a large, abandoned experiment. They wanted him to move ostensibly because cold fusion experiments might produce neutrons or charged particles which could endanger students, but actually because this research is an embarrassment. He soldiers on. Without a research budget he has gradually recapitulated the history of chemistry in reverse. He started with old computers, then went back to analog pen recorders, circa 1900, and now he is reduced to doing calorimetry with a mechanical stopwatch and a mercury thermometer, circa 1840. This method works as well today as it

Other Glow Discharge Research at Hokkaido University

Azumi recently published a paper about glow discharge in the *Japanese Electrochemical Society Journal*.[12] The paper is in Japanese but the title and abstract are in English:

Abstract

Light emission from the metal electrodes cathodically polarized at cell voltages up to 250 V was investigated in various aqueous electrolyte solutions. The light emission was observed when the temperature of electrodes exceeded the boiling temperature of the electrolyte due to the intense cathodic polarization a thin vapor layer was formed at the metal/electrolyte interface in which a high electric field ionized vapor molecules to generate the plasma state. The light emission was caused by a glow discharge at relatively low cell voltages and by a spark discharge at high cell voltages. The spectra of the emitted light were assigned to the constituents of the electrolyte solution, electrode material and gaseous hydrogen evolved at the electrode.

The authors divide glow discharge and electrolysis into three phases:

1) Ordinary electrolysis producing hydrogen evolution. Occurs from 0 to 100 Volts. The mechanism is direct electron transfer from cathode to solution.

2) Glow light emission, 100 to 175 V, indirect electron transfer through a plasma layer.

3) Spark light emission, 175 V and above.

Another paper about this subject was recently published: Sengupta *et al.*[4] describe the relationship between voltage and chemical products, which does not fit the conventional Faradaic laws. They make no mention of cold fusion, excess heat, or calorimetry. They measured input, but it seems unlikely they measured output. They probably assumed the two are equal and no source of significant energy exists within the cell.

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did when J.P. Joule invented it, and it has a certain elegant simplicity, but it takes a lot of work. You cannot let an experiment run for long. You have to babysit, periodically writing temperatures in a notebook. Mizuno has much grander equipment, because he paid for most of it himself, including a new Ulvac quadrupole mass spectrometer, which costs about $25,000. In September a large Japanese corporation donated $10,000 for his experiments.

Mizuno's Note About Heat Release Calorimetry (translated)

Temperature is measured with three K-type thermocouples. One records the cell temperature, and the other two record room and incubator temperatures. The thermocouple leads are covered in 0.1 mm Teflon shrink-wrap. These thermocouples have all been calibrated against a standard (mercury) thermometer. The heat release style cell is made of Pyrex, and it has the capacity of 1000 cubic centimeters. The top portion has a silicon plug. This plug has holes opened in it to allow the passage of the electrical leads and thermocouples. The cell is surrounded by Styrofoam insulation. The cell is placed on a magnetic stirrer, which drives a Teflon mixer placed at the bottom of the cell. The magnetic stirrer is a Yamato brand, model MA300, which spins at selectable constant rate.

The formula for determining the heat balance with this heat release cell system is as follows:

Input = 1xV (1)

Output = Hw+Hc+Hr+Hv+Hg (2)

Here, input and output are measured in joules. I is current (amperes), V is voltage, Hw is the quantity of heat in the water, Hc is the quantity of heat in the cell glass material, Hr is heat radiated from the cell, Hv is heat lost to vapor, and Hg is heat lost to the electrolytic decomposition of hydrogen and oxygen. The terms in detail are:

Hw = mass of fluid x specific heat of fluid x temperature change

Hc = mass of cell Pyrex material x specific heat of Pyrex x temperature change

Hr = (mass of fluid x specific heat + mass of cell x specific heat) x temperature decline

Hv = mass of vapor x heat of vaporization

Hg = 1.48 x current

The amount of fluid is taken as 1000 grams. The specific heat of the fluid varies with temperature, but it is approximately 4.18 joules/g x deg. Hr is computed based on the temperature drop, which is determined by examining the heat decay curve produced after the power is turned off. The rate of change in temperature at every data point is determined. The logarithm of these points is plotted as a function of the temperature difference, and a linear relationship between temperature and energy content is derived. When this formula is applied to the cell mass and heat capacity, Hr is derived according to the following formula: Hr = Mx4.18xAx10^bxT

where M is the thermal mass of the cell, including the thermal mass of the fluid, electrode metal and cell material, based on the weight of the material and a calibration. In this case M equals 1100. Factors A and b are based on the heat decay curve of the fluid temperature. In one example, A equals 0.00190 and b equals 0.0227. T is the ΔT temperature difference between the cell and the incubator air temperature. Hv is the mass of vapor multiplied by the heat of vaporization, which is taken as 2256 kJ/g. However, in the graphed examples of July 8 data, Hv was not taken into account. The last factor in the equation is Hg, heat required for electrolytic decomposition. This varies depending upon conditions at the electrodes, however here is taken as 1.48xI.

Heat generation is computed based on these terms, and input is compared to output. Any difference constitutes excess heat energy.

Comments

If Hr (radiation) is not accounted for, when the cell is run at high temperatures output appears to be less than input. On July 12, a 640-second run was made starting with hot electrolyte at 86.0°C. Input was 68 kilojoules. The water and Pyrex container rose 13°C, absorbing 60 kilojoules, which is only 89% of input. According to Mizuno's calculation the cell radiated 16 kilojoules during the run. Total heat absorbed and radiated was 76 kilojoules, which is significantly more than input. (After the run, as the cell cools, it slowly radiates the 60 kilojoules of absorbed heat until it reaches room temperature.)

Did the cell really radiate 16 kilojoules? Mizuno derived this with the algorithm described above. I reached a similar conclusion with a rough estimate. 16 kilojoules over 640 seconds equals 25 watts average radiant losses. The rate is higher at higher temperatures according to Newton's law of cooling. Just after the power was turned off, the temperature dropped from 99.2 to 97.4°C in 310 seconds. That is, 1.8°C x 4.18 1,100 grams = 8,276 joules. Divided by 310 seconds it equals ~27 watts radiation loss at the peak temperature.

No Easy Path to Technology

One disadvantage of this experiment is that the tungsten cathodes are rapidly destroyed, which would make this an impractical and expensive method of generating power. It does not seem likely that this problem can be easily overcome. The tungsten is not used up in a chemical or nuclear sense. It is not oxidized like burning coal, or transmuted like the uranium in a power reactor. However, it breaks into fine powder which precipitates to the bottom of the vessel. Perhaps the powder could be remanufactured into cathodes, but this would take a great deal of energy—far more than is generated in the time it takes the cathodes to disintegrate. Perhaps something like tungsten black could be used instead of foil cathodes. (Tungsten black is fine powder that is already disintegrated. Arata and others have observed the cold fusion effect in palladium black.) Powder may not work: the geometry of the cathode appears to be important. Only foils have generated heat, not wires, rods, or foils with the edges broken off and rounded after extensive use. In a discussion of Mizuno's experiments, Robert Huggins wrote:[8]

> The disintegration of the electrode in the glow discharge experiments is a major disadvantage. It may be that one needs to cool it internally by flowing water. That is what is done in TIG (tungsten electrode inert gas) welding. It might make the calorimetry more complicated, however.
>
> In addition, what happens on, or near, the surface of the tungsten is apparently very different in the two cases [of CF glow discharge versus TIG welding].
>
> What I think is needed is an experiment that can run in steady state for a long time, so that one can think of making a technology out of it. Short term or transient experiments done to demonstrate the reality of an unexpected phenomenon are just too susceptible to criticism. Especially in the present climate.

Mizuno and Ohmori feel this experiment could be scaled up without much difficulty. More excess heat would probably be generated by a larger foil cathode. The input to output ratio might improve. They cannot test larger samples because their power supplies only have enough capacity to maintain a glow discharge on a 1 cm^2 foil (counting both sides of a 5 x 10 mm foil). As noted above, Mizuno thinks a pressurized cell run at temperatures above 100°C may produce a higher input to output ratio. It might also disintegrate faster. We cannot predict what will happen.

Conclusion

I wrote, "There does not appear to be a missing step or some secret Mizuno forgot to tell us. I did not expect to learn an arcane trick that makes the experiment work. Success will probably depend upon, a plethora of small continuous improvements,[9] and skill developed through training and practice." Mizuno left some steps out of the papers, but we cannot blame him. A paper that explains every detail of an experiment would have to be as thick as a chemistry textbook. Mizuno did not spell out the fact that when he pours the reagent from a jar into a test tube, he tilts the jar and shakes it. He never uses a spoon, because the spoon might contaminate the reagent powder. He did not say this because it is common knowledge; any chemist would know it. Scott Little probably knew it.[10] But Little may not know some other critical piece of electrochemists' lore, which is not common knowledge to most scientists. This would explain why Zhao had no trouble replicating. The KRI has a large electrochemical research laboratory devoted to projects in batteries, fuel cells, and other energy applications.[11]

Mizuno soaks a new platinum mesh anode in aqua regia overnight, dissolving the outer layer of metal. He says an electrochemist will do this out of force of habit, without thinking and without documenting the procedure. We always have a bottle of the stuff handy, and that's the way we do things in this business. Scott Little, on the other hand, may not keep a bottle of aqua regia

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handy, because it is toxic, fulminating acid. Perhaps this step is essential, or perhaps it makes no difference. Perhaps it depends on where you buy the platinum, how thick the wire mesh is, how you prepare the mesh before the acid bath treatment, and whether the wires were drawn through a die coated with organic lubricant.

I cannot spot a critical difference between Mizuno and Little's work because I am not an electrochemist and I have not seen Little's laboratory or watched him do the experiment. The best I can do is to act as a go-between and translator. The used cathodes Little sent back to Mizuno may tell the story. Mizuno himself does not know exactly what he is doing, as evidenced by the fact that the experiment sometimes fails, but it is gradually improving. Kawasaki said that after Mizuno began the glow discharge experiments, prompted by Ohmori's encouraging results, it was several months before they saw excess heat. After I returned to Atlanta, Mizuno did some steady-state, 1000-second runs, and most of them produced excess heat, usually at 150% average. He e-mailed me this news in Japanese. After the usual poetic preamble about warm weather and the sound of cicadas he said, Thanks to your suggestions I have improved reliability. Since I do not recall making any suggestions, and the only thing recorded in the two-hour video are my puzzled questions, I think this means that the discussions I catalyzed between Mizuno and Ohmori were fruitful. They do not often eat lunch together or pause for an hour to discuss their work in front of a video camera. I gave them an opportunity to compare notes.

When you visit a laboratory and spend hours looking over the shoulders of electrochemists at work, you reach the unsurprising conclusion that this research is a mixture of drudgery, common sense, skilled labor, and deep knowledge of chemistry and physics. Since Mizuno does not have much money, he invents simple, cheap, *ad hoc* ways to do things. To make the Styrofoam shell fit the Pyrex vessel snugly, he used two blocks of Styrofoam, an old coffee can the same size as the Pyrex vessel, and a blowtorch. Working in the parking lot outside the building, he heated the inside of the can and pressed it against the Styrofoam, which melted, leaving a gap just the right size. Most of the day-to-day techniques are so simple you wonder, Why didn't I think of that? Many are based on ancient tools like siphons, pliers, and balance scales. Before you insert a mercury thermometer into a cell, you scrub it in pumice and wash it in water, which is probably how an ancient Roman would have cleaned a piece of glass. And why didn't I think of that? If I had several lifetimes, I could reinvent most of the techniques for purifying, cleaning, assembling and testing cells, wrapping and trimming wires, spot welding, and so on. Anyone handy with tools could do it. But to get the job done in one lifetime you must learn from experts.

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An Intel manager's description of the techniques used improve output on a semiconductor production line output. See Lohr, S. 1995. Suiting Up for America's High-Tech Future, *New York Times*, December 3.

10. I asked Little whether he knew this. His reply was ambiguous: Well, I'm certainly aware that contamination is possible with a spoon but I'm also aware of the likely level of such contamination, assuming the spoon is visibly clean to start with. . . If I was doing ppb trace element studies it would be a whole different ballgame. Lots of things would have to go, including all spoons. . . I normally don't use a spoon but, if the reagent is clumpy, I sometimes have to resort to a slender, clean digging tool to loosen the stuff before pouring. I always use a stainless steel rod that has been cleaned thoroughly.

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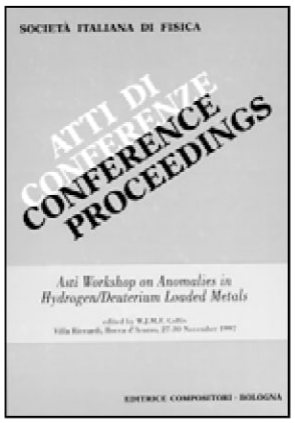

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Letters/CNEA—From page 8

U.S.A.; Beverly Rubik, Ph.D., President, Institute for Frontier Science, San Francisco, California, U.S.A.

*Domestic corps and the overseas corps in Japan which were built under the Japanese law can be the members of this committee with payment of due participation fee.

JTTAS is located in Akasaka, Tokyo. The address: Kyodo Bldg. 4F, 4-3-1 Akasaka, Minato-Ku, 107-0052, Tokyo , Japan. Tel (03) 5573-2701, Fax (03) 5573-2722.

[Note: Ki is equivalent to Spirit in the West. For Ki-energy, refer to S. Inomata, Science of Consciousness and New Scientific World-View: We Are in the Midst of the Second Copernican Revolution, *J. New Energy*,

In Memorium—Mrs. Babbs Clarke

"Our heartfelt condolences go out to Fred and all the Clarke family following the recent death of Babbs.

Our thoughts are with them at this very sad time." *IE Staff*

❑❑❑

New Energy Times Archive

INE Symposium '99 in Salt Lake City

Report by
Jeffery D. Kooistra*

Salt Palace Convention Center, Salt Lake City, Utah

I attended the Institute for New Energy's INE-99 Symposium for New Energy (August 27-28, 1999) pretty much *incognito*. You see, Dr. Ruggero Santilli had a prominent spot on the roster at this event, and since his ludicrous lawsuit against us (see *IE* No. 27, p. 75) was rather freshly in the air then, I didn't think it would be fair to come to the meeting with too high a profile. After all, I was going only as a reporter, and I didn't want to become a part of the story. So I didn't "press the flesh" very much or mingle as I would have liked to, even though there were some personal "giants" there with whom I would have liked to talk to in depth.

I was able to attend the entire day of the 27th, but my flight schedule meant I could spend only a few hours at the Saturday morning session on the 28th. So this report will not be as complete as was my earlier Conference on Future Energy (COFE) article (*IE*, No. 25, pp. 10-15). This will just give you a flavor of the Symposium. Those interested in pursuing subject matter discussed at the conference in more detail can avail themselves of the INE website at www.padrak.com/ine/.

The Symposium was held in beautiful Salt Lake City, at a convention center called the Salt Palace. Although the Salt Palace was huge, the Symposium was not. I counted heads that first day and found just over fifty or so people in attendance. Since at least a third of them were either presenters or reporters, this left precious few as mere attendees. This was a disappointment for me, coming so soon after the well-attended COFE.

Patrick Bailey opened the Symposium with a few remarks about the INE and its history, in which he and Hal Fox have played a large role. He then introduced Friday's first speaker, Tom Valone. Valone's talk was on "Breakthroughs in ZPE and Remaining New Energy Problems." Much of what he discussed can be found in Valone's article that we published in *IE* No. 26, but there were a couple of other things he brought up that I want to note here. Tom mentioned that he'd been reading Kuhn's *The Structure of Scientific Revolutions.* I am so familiar with this book myself that I sometimes forget that others may not have read it. Suffice to say that you don't know what a "paradigm" is until you've read Kuhn, so this is a definite must-read book. There was also a discussion of what the "black world engineers" are up to. I call this the "Greer Influence." Dr. Steven Greer made quite a splash at COFE with his talk about UFO matters vis-à-vis the New Energy field. This was a welcome opening. All of us in the New Energy field should be prepared to come to grips with the idea that maybe what we're pursuing has already been done in the shadows of the black budget world.

Patrick Bailey

Tom Valone

Following Valone's Q&A it was time for Dr. Santilli to speak. Much of Dr. Santilli's theoretical discussion has already been printed in the pages of *Infinite Energy*. I must admit, I enjoyed the passion and energy of his talk. He was an exciting speaker and I wish I could have been listening to him under less acrimonious conditions. After Dr. Santilli's first talk, he and Leon Toups of Toups Technology Licensing made their big announcement about MagneGas.™ Toups gave Dr. Santilli full credit for the discovery, and this gas was touted as the first validated demonstration of an over-unity fuel (of a sort) since the discovery of nuclear fission. Since Gene Mallove knows more about the history of this fuel, I'll defer to his account, which follows this article.

Leon Toups

Dr. Ruggero Santilli

After Santilli and Toups, Professor Domina Spencer of Boston University and the University of Connecticut spoke on the subject of "Criteria for Electrodynamics in the Next Millennium." This was highly enjoyable for me, because I've read many of the papers she has co-authored with the late MIT Professor Parry Moon. She is a critic *par excellence* of conventional electrodynamics. She discussed four criteria that any formulation for electrodynamics in the next millennium must satisfy, among these being validity in all curvilinear coordinate systems and a correct postulate for the speed of light.

Prof. Domina Spencer

After lunch Dr. Lawrence B. Crowell spoke on "The New Maxwell Electromagnetic Equations." This was supposed to be one of the big breakthrough announcements of the conference. Unfortunately, after the talk, Dr. Spencer was forced to ask him, "What *are* the new Maxwell's equations?", since Dr. Crowell didn't give us any! At best, I guess it could be said that Dr. Crowell presented evidence for a non-linear correction in Maxwell's equations, and his talk likely would have gone well at a physics department seminar. But he spoke way over the heads of most of those in attendance, his title was misleading, and he seemed unaware of much of the other work going on that has been attacking the foundations of electrodynamics for years. I'll never forget the moment that Dr. Spencer asked him about the force law he was using. He said that it was just the Lorentz Force law. She responded: "But that's wrong!"

Dr. Lawrence B. Crowell

Following Crowell came Mark McLaughlin of the Alternative Energy Institute. This group disseminates all kinds of alternative energy information via the web. They have links to *Infi-*

**Photos by Jeffery D. Kooistra*

New Energy Times Archive

the Lorentz Force law. She responded: "But that's wrong!"

Mark McLaughlin

Following Crowell came Mark McLaughlin of the Alternative Energy Institute. This group disseminates all kinds of alternative energy information via the web. They have links to *Infinite Energy's* website, for instance. Mark's talk was clear and concise, and I encourage you to check the site out for yourselves at www.altenergy.org.

Dr. Panos T. Pappas

After McLaughlin, Dr. Panos T. Pappas spoke on both "Na-K Nuclear Transmutation Inside the Living Cell" and "The Lost Unified Theory: The Ring Model of the Electron." The first of these involves the exciting hypothesis that, essentially, cold fusion reactions go on within the human body. It has been reported for years that forms of transmutation occur in biological systems. (See *IE* No. 27 for the report by Mallove and Bockris.) Pappas presented evidence that potassium increases in the presence of excess sodium in the human body. He also suggested that what powers the human body is not a chemical reaction, but a cold fusion one!

The ring model of the electron is an old one dating from at least 1915, though precursors to that in vortex models of the "atom" can be found in the previous century. It is felt by Pappas and many others that a model of the electron involving structure, ring or otherwise, answers far more questions more simply than does the usual *ad hocery* of standard QM. According to Pappas, the ring model "explains more completely the atomic spectra, including the new experimentally verified radiation in the range of 80-650 A, (Labov, 1990) for hydrogen and helium, which is not explained or predicted by classical Quantum Mechanics."

Dr. Dan Sewell Ward

Dr. Dan Sewell Ward spoke next on "Inertial Field Theory: A Radical Change of Pace." The abstract for this talk has more meat in it than I can give the talk here, and I recommend that you read it at the INE website. Much of this work builds on the pioneering achievements of William O. Davis and G. Harry Stine in the early sixties. The goal of such research is to make propulsion systems which do not require reaction mass. I enjoyed the talk and I enjoy this kind of work, but I want to put in a couple of cents worth of my own. At one point Dr. Ward brought up connections of his work with the ZPE and, frankly, I couldn't see the relevance. I welcome a correction on this from Dr. Ward, but it seemed to me that his theoretical work will get along just fine without resorting to the zero-point field. He also brought up Mach's Principle and suggested that "by 'tweaking' the rest of the universe in a clever way, unlimited amounts of energy may be obtained."

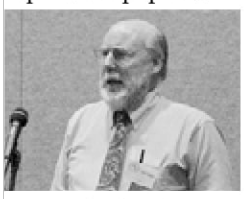
Hal Fox

Mach's principle is enjoying something of a resurgence lately. I don't mean to take issue with Dr. Ward's talk, but I do want to alert readers to my own view, which is that my own Warlock's Wheel, reported on in the last issue (*IE* No. 27, p. 49), both violates Newton's third law and can be explained entirely locally—that is, without recourse to the rest of the universe.

Moray King

Tom Bearden was scheduled to speak after Dr. Ward, but Bearden couldn't make it. Hal Fox filled in and summarized Bearden's paper, but since we were already running late, Hal made that presentation very brief.

Moray King followed Hal. Since we have reprinted King's article in this issue, I'll refer you there since the amount of overlap of that paper with King's talk is significant (see page 64).


Don Reed

The final talk on Friday was by Don Reed on the topic of "Torsion Field Research and Implications for New Physics and Energy Technologies." I have to confess that, though I have been aware of torsion field research for a few years now, I still don't have a nice, simple way to describe just what a torsion field *is* or how one could describe it in layman's terms. Although Reed's talk was interesting, the subject can't be summarized easily. It's well worth your time to look into, though, and since you should be going to the INE website anyway, I suggest that you read up a bit on torsion fields.

I could only stay for a short time on Saturday before I had to catch a flight, and I spent most of that time having a nice conversation with author Jeane Manning. So I was only able to hear a portion, albeit a delightful one, of Domina Spencer's sec-

"MagneGas™" Announced at Symposium

Report by Eugene Mallove

At INE-99, two spokespeople for Toups Technology Licensing, Inc. (TTL) of Largo, Florida discussed a new kind of gas, which TTL has dubbed "MagneGas™." According to the company press release (see also www.toupstech.com), MagneGas™ was developed by TTL "in collaboration with" Dr. Ruggero Maria Santilli, who was the keynote speaker at INE-99. Leon Toups, President and CEO of TTL, also introduced the gas in his INE presentation. TTL is a publicly-traded corporation (NASD OTC-BB: TOUP).

MagneGas is apparently of a lineage of gases that are produced by electric arcs in water that may contain organic materials—such as AquaFuel™ or CarboHydrogen Gas™, which have previously been discussed at length in *Infinite Energy* (see *IE* No. 9, pp. 44-48, *IE* No. 10, pp.32-48, and *IE* No. 11, pp. 35-42). The apparent new twist with MagneGas is that the solution from which the gas is formed is initially treated by magnetic fields. TTL claims that the gas is "over-unity" in the sense that "the MagneGas process generated 2.78 times more energy in the form of combustible gas than it took to make the gas." These results come, TTL says, from "an independent third party certification" after "tests and measurements conducted by TTL technicians under Dr. Santilli's supervision." The third party certification comes from Florida-based Motor-Fuelers, Inc.

As with the other electrically manufactured carbon-containing gases discussed in *Infinite Energy*, MagneGas appears to have a very clean combustion when burned in air: only 120-140 ppm of hydrocarbons (compared to over 13,000 ppm in gasoline exhausts), 14-15% oxygen (compared to 0.5% in gasoline exhausts), and 2-3% CO_2 (compared to 9-10% in gasoline exhausts). In fact, the TTL press release states, "It has a positive oxygen balance, making it the only known fuel whose

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DEVICE AND PROCESS TESTING UPDATES

Ed Wall and Jeffery D. Kooistra

On the electromagnetic side of things, the frontiers of knowledge were pushed back not at all since our last update. However, the reasons for this are good ones—we were concentrating on patenting and putting together demonstrations of the things we've already discovered for potential investors. So now we are acquiring more computing power and more machine shop tools so that the onslaught against the unknown can really progress at high speed.

On the cold fusion side, incremental progress has been made in researching the best processes to investigate and the best methods for proceeding in these investigations. Testing is proceeding on the Case cell. Because the Case cell investigation has been going on so long, a brief history seems in order.

Case Cell History

The idea of gas-phase cold fusion predated Dr. Les Case's experiments, which were announced at ICCF-7.[1,2,3] However, the use of industrial catalytic material for cold fusion work did not attract much attention before he did his long series of tests to determine if such efforts might be commercially valuable. He came to the conclusion that an aneutronic nuclear process occurred that resulted in the production of substantial amounts of helium and excess heat within his cells using deuterium gas with a catalyst from United Catalysts, Inc. The externally heated catalyst and deuterium gave excess temperature readings, compared to runs where ordinary hydrogen was used in place of the deuterium. This announcement generated considerable excitement, and some replication work, including the first observation of the "excess temperature" effect right here at NERL (see *IE* No. 19, pp. 32-35).

EarthTech's Scott Little quickly put together a cell to see if he could confirm the claims.[4] In a series of runs with a cell configuration that did not at all closely resemble Case's cells, no excess heat was detected in eight runs. The cell used three thermocouples inserted at different depths into the catalyst, and so a thermal gradient could be recorded. The cell was enclosed in insulation that was inside a flow calorimeter envelope, an insulated coil of copper tubing. Water flowed through the tubing and was warmed. The flow rate and measured increase in temperature determined the reported heat output of the calorimeter. Little obtained very nearly the same heat out as heater energy in for all the reported runs. He did report slight excess temperature in run 1b, but none in run 2, 3, 4, or 5. Run 6 had a slight increase in deuterium temperature, but none was noted in the catalyst bed. That run had an interesting thermal oscillation in gas temperature, which he believed to be due to thermal instabilities. It was repeated with quartz chips and the same anomaly was observed. In run 8, he did not use regular hydrogen, so no comparison of temperature was made, only heat determination was done, and no excess heat was seen. Little wrote, "There was no sign of the gradually increasing temperature that Dr. Case has observed."

Les Case lent a small cell to NERL, which he took the time to demonstrate to Gene Mallove. In this experiment, definite excess temperature was seen. Its characteristic was a gradual increase from above the established hydrogen baseline over several hours. In further experiments, we did not have the very same heating mantle that Dr. Case employed, so we improvised by placing a mantle at the bottom of a large Dewar and placing the cell on top of it and covering the Dewar. The cell had one thermocouple in the thermowell. At that stage, our calorimetry was rather simplistic, but gradually grew more sophisticated. Thermocouples were attached to the neck of the cell, which would provide data that was thought to be independent of the difference in heat conduction between the two gasses. In fact, no excess temperature of the catalyst thermowell or the neck temperature was found over an extensive set of runs. The variability of room temperature caused problems, so a constant temperature hood was constructed to improve the data resolution, but still no excess temperature was seen.

The repeated hydrogen charges and pressurization took their toll on the cell, which was made from a World War II surplus stainless steel oxygen bottle. Something called "stress corrosion cracking" was occurring in the vicinity of the welds. After a couple of welding repairs (see photo 1), and more cracking, the cell had to be abandoned. Dr. Case was kind enough to provide us with an unmodified oxygen bottle to get us back in business.

By considering the difference between Case's arrangement and ours, it became apparent that both in Little's setup and in our Dewar, the cell was exposed to very little temperature gradient. Perhaps that gradient was essential to the process. Within the hood, the cover on the Dewar was removed and a fan was installed to blow the constant temperature air onto the exposed top of the cell. Getting the catalyst to the desired temperature range required much more heater power. A big temperature difference was also found between deuterium and hydrogen runs at the same heater power. Surprisingly, a similar temperature difference between different hydrogen runs at the same heater power was found. Any slight movement of the cell in the Dewar resulted in big catalyst temperature swings. This was disturbing, because it cast into doubt any sort of calorimetry that relied on simple thermometry. It was apparent that an actual calorimeter would have to be constructed. The calorimeter would have to allow for exchanges of gas without disturbing the cell.

It seemed possible to improvise something resembling a Seebeck Envelope by using the constant temperature air as the reference medium instead of the outside wall of a chamber. This idea may have merit, but after some failed efforts, it was decided to go ahead and build a water flow calorimeter, with a lot of help from Scott Little and Mike Carrell. Much has been written

Photo 1: Original Case cell, with welding repairs of stress corrosion cracking.

about this in previous Updates, so only the current status of the calorimeter at this time will be described. It works well, but the environment temperature fluctuations were still a problem, so a chamber was provided around the insulated tubing coil that is kept at constant air temperature. This results in some very steady heat readings, so steady that the biggest problem with heat output readings is that the peristaltic pump flow rate varies (as much as 1% in a day), which may be improved by enclosing

Newtonian Time Machine

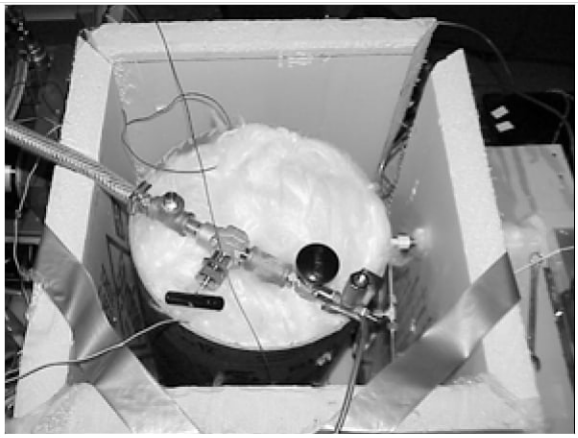

Photo 2: Top view of insulated flow calorimeter coil in constant air temperature chamber.

the pump inside the constant air temperature chamber.

We have just reached day 32 in an almost continuous deuterium run that has seen the temperature of the catalyst gradually rise (it is still rising slightly) around 32°C above hydrogen baseline. We can think of no prosaic explanation for this anomaly, yet there does not seem to be a corresponding quantity of excess heat as measured by the flow calorimeter. Although the higher catalyst temperature with deuterium only occurs with convection currents, those currents are not believed to be the cause of the slow temperature rise, because it is such a steady rise.

This large excess temperature only occurs when there is a considerable thermal gradient across the cell. The setup has about 20 feet of 1/4" tubing wrapped around the top of the cell, circulating cool water, while the heater is driving the catalyst bed to over 200°C. The resulting thermal convection has to be considerable. Photo 2 shows the top view of the large coil with the cell inside, packed in fiberglass insulation, all within the constant temperature air chamber. A thermistor assembly is visible on the right. The layer of fiberglass insulation was installed around this big coil to reduce heat losses other than via water flow.

While we do see some rapid excursions in the temperature readings from the two thermocouples in the thermowell buried in the catalyst bed, they are less than 0.25°C, which is dwarfed by the slow trend in temperature increase (see Figure 1). It should be noted that some increase in catalyst temperature was seen with ordinary hydrogen. The rapid excursions are presumed to be due to convection currents.

A sampling canister with a Nupro bellows valve (very slow helium leakage) was purchased to sample our deuterium gas and sent to SRI. Fran Tanzella (Dr. McKubre's associate) ran tests on it and determined that the helium concentration was quite low, in fact, less than 0.1 ppm (5.22 ppm is atmospheric concentration). We are now at the point where we will sample gas from the cell and have the helium level determined again at SRI. Along with helium, nitrogen levels would be useful to determine whether atmospheric helium might be a possible source.

The change in the calorimeter to implement the constant temperature chamber essentially invalidated the pre-run calibration. Consequently, any determination of excess heat will be performed by a post-run calibration. This will be performed after many prolonged vacuum pump-downs of the cell, using a cold trap, and charging with ordinary hydrogen in order to remove all of the deuterium. This is done with the catalyst heated to promote release of trapped deuterium. It is expected that the pump-down cycles will continue until a consistent temperature reading for catalyst temperature is attained.

The heat measurement in the flow calorimeter is not as precise as would be needed to be confident in small amounts of excess heat. The standard deviation (sigma) of the heat output, which has been rather constant since the installation of the constant temperature chamber (15 days) is 0.2 W. Therefore, a minimum excess heat of 0.6 W is required to be seen as statistically significant excess.

The power to the cell heater was turned off and the cell cooled overnight. When the heater's regulated power supplies were turned back on, the input power returned to its former level, as did the catalyst temperature and the heat measured in the calorimeter. The catalyst temperature did not repeat the weeks long slow rise to get back to 223°C, where it was when the heater power was killed.

In summary, any excess heat is small and will be determined after the run is complete and calibration is performed with regular hydrogen. Helium analysis of the cell gas will be conducted at SRI.

HydroSonic Pump™

After many months of waiting and anticipation, the nominal 75HP device was activated for the first time here on the night of October 13,1999; the local utility company required we run it at night. It seemed to run all right, but readings for current and voltage on the three phases seemed very high. This may be a result of the SCR controller, which switches power at each cycle in order to optimize power factor, creating a very non-sinusoidal waveform and confounding the power analyzer. That feature will be disabled for the next run, which will not be conducted until we can arrange for a better water flow system. The water flow rate was much too slow, but was all that our building's well pump would provide. The output water was boiling in about a minute, with temperature climbing rapidly.

For now, we have no useful test data to report on the Griggs HydroSonic Pump™, other than a successful power-up.

Pantone Engine

Paul Pantone called recently to tell us that his company, Global Environmental Energy Technology (GEET)[5], decided to give away the plans to their main technology in the hope that people would take advantage of it. Paul has spent a large portion of his life developing a process that has the ability to make ordinary internal combustion engines capable of using fuels that are not ordinary fuels. Simply put, the device uses exhaust heat to pre-treat the air/fuel mixture on its way to the combustion chamber. On first inspection, the idea certainly seems like a good way to recover some waste heat, and it turns out that automobile manufacturer Jaguar, among others (see his website), have investigated this sort of method for their own reasons. A distinct feature that Pantone employs

Device and Testing—See Page 51

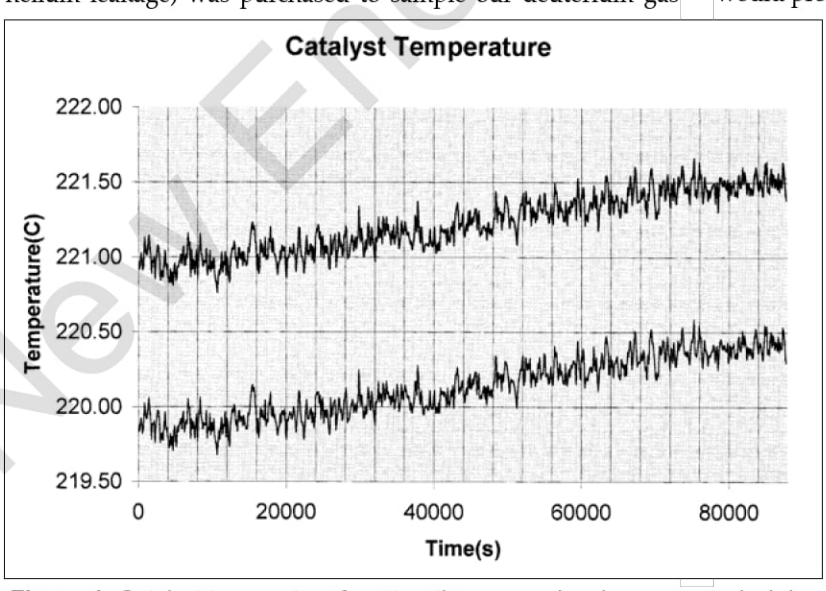

Figure 1. Catalyst temperature from two thermocouples rise over a typical day.

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The Mallove-Park Non-Debate

Commentary by Jeffery D. Kooistra

Infinite Energy editor Dr. Eugene Mallove was supposed to debate Dr. Robert Park of the American Physical Society on July 7, 1999, on radio station KPCC-FM, a PBS affiliate in Southern California. I say Gene was *supposed* to debate Dr. Park because, even though they were both there on the radio, only Gene was actually prepared to debate.

God forbid that we should reprint the entire transcript of the radio show here. Gene acquitted himself well, but the audience was not likely up to speed on cold fusion so Gene had to keep his side of it quite elementary. However, something needs to be said about the "not really being there" aspect of Park's side of the debate. Just as Park puts almost no work into his "What's New" column, he certainly didn't put any work into this debate.

But let's go to the transcript and I'll show you what I'm talking about. The debate began with the usual introduction of the hosts and guests:

Larry Mantle (LM): *This is Air Talk on KPCC, our weekly science segment with correspondent Michael Shermer joining us. And, tonight, we're looking forward to a hot debate on the topic of cold fusion. Hard to believe it's been a decade since researchers at Utah University claimed that they had found a table-top way of actually creating this very clean and abundant source of energy, cold fusion. And, in the intervening years since, Michael Shermer, cold fusion has sort of at least in general public conversation, fallen away. We haven't heard much about it.*
Michael Shermer (MS): *It cooled down.*

OK, so far, so good. Mantle and Shermer, though amiable hosts, were nearly as naive about CF as their audience was likely to have been. At times, it showed.

LM: *All right, let's introduce our guests. We begin with Dr. Eugene Mallove . . .*

IE readers don't need to be told about who Gene is, but I wanted to give you a flavor of the hosts before getting on to Dr. Park's comments. But just a bit more flavoring is needed. Right after being introduced, Gene gave a cracker-jack summary of what's been done since the P&F experiment, which was followed by this exchange:

LM: *A little bit later we'll get your thoughts on why it's not been a replicated experiment.*
Gene Mallove (GM): *It has been replicated.*

OK, so the hosts don't listen to their own show even while doing it. Be that as it may, we then got to the introduction of Dr. Park:

LM: *Let me introduce our second guest, Dr. Robert Park, professor of physics at the University of Maryland and director of the Washington office for the American Physical Society. Dr. Park, we appreciate your being with us.*
Robert Park (RP): *It's a pleasure.*
LM: *What makes you a skeptic about this phenomenon of cold fusion?*
RP: *Well, I keep waiting for something to happen. You know, it has been ten years since the announcement was made and in that time nothing has happened. The arguments that are going on are the same arguments that were going on two months after the announcement was made. The evidence is no clearer now than it was then. And, more tellingly, there is no device. The predictions keep coming and, in fact, Dr. Mallove has made many of those predictions himself. In fact, a few years ago he was vice-president of something called Clustron Sciences, that was getting ready to market cold fusion. Somehow, Clustron Sciences disappeared and the devices never showed up.*
MS: *So, you're waiting for the results to come in? You want to... Show you the money, so to speak.*
RP: *That's always the final test. I mean, something has to happen and nothing has happened in ten years.*

Oh, sigh. Nothing has happened? We've only had excess heat observations and nuclear product evidence up the wazoo since 1989, but for Dr. Park, that doesn't matter. By his own implicit standards, nothing has happened in hot fusion either since 1989. But like I said, Dr. Park wasn't there to debate. His style is to deny that anything has happened, period. To prepare for this show, all Dr. Park did was look at the calendar, subtract 1989 from 1999, and scribble "ten" into the appropriate spots on the lyrics sheet of the same old song he's always sung.

Right after this Gene went ahead and set the record straight. The hosts certainly weren't going to be able to challenge Dr. Park. During Gene's lengthy explanation (lengthy because a lie told in ten seconds can take ten minutes to refute), he accused Park of "conning the audience," which brought on the following exchange:

MS: *Dr. Mallove, "con" is a pretty strong word.*
GM: *It is. He said nothing happened.*
LM: *Dr. Park, how do you respond to that?*
RP: *It's kind of usual, his reaction to this. When I say nothing has happened, I'm looking for these devices. He keeps predicting that in "five years something's going to happen." He's been predicting that since 1991. Well, I can read, in fact, from one of his predictions here: "that these developments vindicate the work of Pons and Fleischmann and suggest the onset of an unprecedented technological revolution." He's usually using the term "five years," but he has been using that year after year after year.*
GM: *If I may add, it seems...*
LM: *We're talking slightly at cross-purposes. Dr. Park, do you mean when you say you want something to happen, do you mean an actual workable device that can be sold to the public or do you...*
RP: *I would like to see a device that anybody believes is working.*
GM: *Okay, well that's a good point.*
RP: *. . .not just the cold fusion true believers.*

Now, one needs to wonder if any thought went into this reply by Dr. Park at all. Apart from the utter non sequitur of whining that Gene was overly optimistic in the past, what in the world does the presence or lack thereof of a device one can buy in K-Mart have to do with the reality of an effect? Does K-Mart sell anything that works on the Aharanov-Bohm effect? No. Does the effect not exist then? No. Have not Hot Fusioneers been predicting power plants "thirty years from now" for the last thirty years? Yes.

Does Dr. Park have anything like a valid point here? No.

The debate continued. Gene kept trying to make the debate an actual debate, and he tried to bring relevant science back into it. In reply to Dr. Park's comments, Gene quoted Dr. Park himself:

GM: *This is an excellent point that I think Dr. Park and I should discuss. You see, if you're talking about a device like a car or a heater that you can buy at Sears or K-Mart, we obviously don't have that. If you*

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are talking about peer-reviewed literature—and you can go to our website or many other websites in the cold fusion field and determine that there are these peer-reviewed and non-peer-reviewed documentations of helium, which Dr. Park asked about in 1991 and 1989, which he's conveniently forgotten about. This is the kind of evidence that normally, in the normal course of science, after someone makes a statement such as Dr. Park did in the Chronicle of Higher Education, *June 14, 1989. He said this, "The most frustrating aspect of this controversy is that it could have been settled weeks ago. If fusion occurs at the level that the two scientists claim, then helium, the end product of fusion, must be present in the used palladium cathodes." Well, we've got it now from Dr. Miles, Dr. Melvin Miles at China Lake Naval Surface Weapons Center, in a published Navy report. We have it from Dr. McKubre now, who reported that at two locations where Dr. Park could easily have been; one by the way was at his own APS meeting on March 22, 1999...*

Now, had this been an actual debate, Dr. Park would have had to answer for his own previous comments. Instead, there followed an exchange with one of the hosts, and after Gene, again, reviewed the history of the field, including replications and the MIT shenanigans (covered extensively in *IE* No. 24), we finally were treated to Dr. Park's "reply":

MS: *Now, you actually think that somebody covered something up?*
GM: *There's no doubt about it at all.*
MS: *Dr. Park, is there some doubt in that?*
RP: *My goodness, that is interesting. Dr. Mallove, of course, was at MIT at one time. His employment there was terminated.*
GM: *No, it was not! I resigned! I was not terminated. Pardon... Wait a minute... We will not... Excuse me, we will not have...*
RP: *It was a press release on MIT letterhead, when in fact MIT had nothing to do with the press conference. As I understand it, that resulted in the termination of his employment.*

Park lied. You might want to ask yourself why the APS sees fit to keep such folks around as spokespeople.

After this, Gene went on to explain how he'd resigned and not been terminated. This was to set the record straight for the audience since Park already knew the truth.

After a break, the hosts picked up again. I'm going to include all of Gene's reply since this is one of the most representative parts of what a debate is like when only one side shows up.

LM: *Gentlemen, let's move back into our conversation. Dr. Mallove, let me ask you, if you can in a very simple way describe how you believe cold fusion does, in fact, work.*
GM: *First of all, I will tell you how at least one form works. What you have is you have electrolysis, which is a standard process. In the case of Pons and Fleischmann, it was the electrolysis of heavy water, which is in all water. It's an isotopic form with a heavy hydrogen form,* D_2O *not* H_2O. *You split that and the heavy hydrogen goes into palladium... Let's talk about the, as I say, original Pons-Fleischmann excess heat experiment -- it goes into this lattice. Everyone agrees with that, the skeptics, the people that Dr. Park and company call "true believers," "pathological scientists." Everyone agrees the heavy hydrogen packs the lattice of palladium and then the question after that is: what happens in that lattice? Now, the fact of the matter is, we're dealing with a solid state here. A solid-state phenomenon, which is more complex in many respects than the fairly complex hot fusion or plasma fusion which occurs in vacuo where you are dealing typically with isolated particles. Now, there are theories that say that in the solid state, some unusual quantum effects could occur and you might get by various coherent mechanisms, laser-like mechanisms, other types of mechanisms, that you could get the production of helium-4, which is the product that Dr. Park wanted to see, as he told me in 1991, and as he demanded in the* Chronicle of Higher Education *in June of 1989. You can get that. Now, the interesting question, when Pons and Fleischmann made this announcement, was two-fold.*

Number one, are they getting nuclear products of any kind? That was more difficult in the early days. And, indeed, they, by their own admission, were not prepared to make this announcement. They, frankly, didn't want to make the announcement; they wanted to wait eighteen months, but because Steve Jones nearby at Brigham Young University sort of forced the issue by wanting to talk about it at the American Physical Society meeting May 1, 1989, he kind of forced them both out into the open for patent issues. This helium-4, this is a key thing. The helium-4 would normally be expected in hot fusion to produce a very deadly gamma ray, 23.8 million electron volts. What cold fusion people are seeing, such as Dr. McKubre at SRI, Dr. Les Case in New Hampshire, Dr. Melvin Miles at the Naval Weapons Laboratory and others in Italy and so forth, they are seeing helium production with attendant heat that is commensurate. In other words, you take what would have been 23.8 meV gamma ray, turn it into some kind of heat that goes into the palladium lattice, and Voila, there you have cold fusion. The fact that we can't make a machine, yet, that you can buy at K-Mart but that we do have in the peer-reviewed literature is no more condemning of cold fusion than it is that in 1947 when we had the transistor, we didn't have transistor radios or the computer yet.
MS: *Okay, Dr. Park, let's go to you and ask what would satisfy you as a cold fusion skeptic? What sort of article published, peer-reviewed article or journal or conference or type of experiment would it take to turn your mind on this?*
RP: *Well, it's not one experiment that you're looking for. If I could draw a comparison and then have a little exception to your talk about socially constructed science, an example would be the discovery of high temperature superconductivity. Just a couple of years before the announcement of cold fusion, it created a similar furor. As you may recall, it also made a prediction that was contrary to normally accepted models of how superconductivity works and yet when they released that paper, they gave all the details for how to do it and within days, other scientists everywhere were in fact building high temperature superconductors and even high school and junior high school laboratories were able to manufacture it because they had the precise details of how these people had done their experiment. It was reproduced over and over. Nothing like that has ever occurred in the case of cold fusion. And, in fact, if we could get back to that question of the helium in the metal lattice, what I demanded in 1989 has still not been produced.*
GM: *Not true.*
RP: *What I demanded was that the cathodes that were used by Pons and Fleischmann be released to the scientific community for analysis. They were never released. The results were never published. They contended that they would have them done privately by a firm in England. That analysis was done and then they refused to announce the results of the analysis. Now, something is wrong and it's been wrong ever since. And, in fact, Pons and Fleischmann as you may know, lost a court case in Italy after they were accused of being frauds. They took the reporters to court and they lost and paid all the costs.*

So how do you debate a guy who doesn't want to debate? Read what Gene said above and then look at Park's reply. ". . .it's not one experiment that you're looking for. . ." Well, duh. Gene had just reeled off a bunch of them. But then, Park didn't care about that—he just wanted to make a comparison with high temperature superconductors and then not so subtly accuse Pons and Fleischmann of fraud. That the comparison with HTSC was entirely inapplicable didn't seem to bother him. As Gene was able to point out later in the discussion:

GM: *. . . I wanted to reply to what Dr. Park had said earlier about high temperature superconductivity. He was absolutely correct in his*

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characterization of what happened with high temperature superconductivity two years before cold fusion. Absolutely right on; it was very easy to replicate that. People did replicate it and it did get into high schools very quickly. The misfortune of cold fusion doesn't have to do with the fact that some unusual things from the American Physical Society or even MIT hot fusioneers occurred, but basically it was a more difficult phenomena. Much more difficult. It wasn't like mixing fairly well-characterized ingredients in ceramic, compressing it in a certain way, sintering it, whatever they did, and then making it superconduct. By the way, I note today and I have colleagues, MIT colleagues, who are in high temperature superconductivity, there is no a) accepted theory for it even today over ten years and b) there aren't very many prominent if almost any major products involving high temperature superconductivity, even though it indeed was easily replicated. Cold fusion wasn't easy to replicate.

But beyond this is this queer comment about the P&F cathodes being released to the scientific community. Since 1989, cathodes showing helium have abounded. The P&F experiment has been replicated by others. What did or did not happen with the original cathodes has nothing to do with cathodes produced now. But from Park, just more whining and half-truths.

As the discussion continued, Dr. Park didn't improve upon his performance. For instance, Mr. Shermer brought up a valid point about how the public is supposed to distinguish valid, though perhaps not generally accepted science on the edges from the usual gamut of "lunatic fringe" stuff. As he asked of Gene:

MS: *. . .so how are we to distinguish between what you're doing and what other people sort of on the margins are doing?*
GM: *You made an excellent point. I do think it's a valid point because your listeners have no way of knowing, really, whether Dr. Park is right or whether I'm right. They have no way. The only way they can possibly do this is by consulting the peer-reviewed and non-peer-reviewed technical literature. It is a fact of life that there are reports published in prominent journals, such as the publication of the American Nuclear Society called,* Fusion Technology. *Anyone in a good engineering library can look at what's being published there and since September of 1989, these are peer-reviewed cold fusion articles appearing in a hot fusion journal, edited by George Miley. There's* Physics Letters A. *There's the* Proceedings of the National Academy of Sciences *where Julian Schwinger, who was a cold fusion theorist, has published. There is work published by national laboratories, such as the work of Dr. Miles at Naval Air Surface Warfare Center, Dr. Edmund Storms at Los Alamos, Dr. Claytor still working at our Los Alamos National Laboratory getting tritium results. My suggestion is this: forget about Dr. Park. Forget about Dr. Mallove, for that matter. Why not, for those scientifically inclined among you, just go consult the literature and see whether this is some kind of whim. . .*
MS: *Okay, well. . . Dr. Park, I guess part of the problem I have with that answer is I've tried to read these peer-reviewed papers on cold fusion and I just don't understand them and I'm a science kind of guy, mostly the social sciences. But even in the Infinite Energy magazine articles, I just can't understand them. I guess I rely on people like yourself and my buddies at Caltech to just sort of tell me if this nonsense or if there's something to it. So, how are us non-technical people to sort of judge on these kinds of debates?*
RP: *Well, of course, a peer-reviewed article does not mean the article is correct. All it means is that the peer-reviewer cannot put his finger on anything that is obviously wrong. It doesn't mean that the experimenter told the truth. It doesn't mean that his instruments were working properly. It doesn't mean a lot of things. All it means is that the reviewer has gone over it. Now, as a matter of fact, most of those so-called peer-review papers are published in one journal, as Dr. Mallove mentioned, a journal's whose editor is in fact a true believer in cold fusion. In fact, who is funded to study cold fusion. So, you know, that just doesn't carry a whole lot of weight with the scientific community.*

This was the first part of Dr. Park's answer. It's lame, but at least for once he was responding in the direction of actually debating. Unfortunately, the rest of the exchange went as follows:

RP: *I'm more interested in this K-Mart problem that Dr. Mallove mentioned. I'm reading here from something that Dr. Mallove wrote to the House Subcommittee on Energy. It says, "Prototype cold fusion home heating units are widely expected to emerge this year or next. Electrical power generation by cold fusion will follow soon thereafter..."*
GM: *I did think that then, yes.*
RP: *". . . and perhaps aircraft propulsion by cold fusion within a decade." That was written in 1993.*
GM: *A decade hasn't gone by yet.*
RP: *Where are these home heating units?*
GM: *Well, there are. . .*
RP: *Where are the water heaters that we've been hearing about for years?*

Oh sigh and poo-poo—Johnny one-note comes marching home again. By this time, the debate had gotten to the call-in portion of the show. Dr. Park continued to read from his old notes whenever possible, and there's not much use in reprinting that here. But there was one exchange that merits bringing up since it seems to offer insight into Dr. Park's thinking:

MS: *Dr. Park, I'm curious of your opinion on this, because it certainly got my attention. The fact that Arthur C. Clarke has endorsed cold fusion. He said 99% probability of it being true. Obviously that certainly gets the attention of those of us who respect people like him. What do you make of that?*
RP: *Well, he's an interesting guy and he imagines himself something of a futurist. His most famous prediction, as you may recall, was that we would use earth satellites to relay communications messages around the world. And, of course, we do. The satellites he had in mind, I might mention, were huge manned devices with a large crew whose job it was to replace the vacuum tubes. And, of course, that wasn't necessary. But, on this I think he's just simply mistaken.*

". . .he imagines himself something of a futurist. . ."? Earth to Dr. Park! Every literate person in the western world thinks Sir Arthur C. Clarke is a profoundly successful futurist. People still read Clarke's *Profiles of the Future*, despite its having been written in 1963, whereas there's nothing so old as even last year's "What's New" column.

Since Dr. Park didn't genuinely want to debate, I think it's fair that we leave this non-debate with a few salient words from Gene:

GM: *. . .It has been disappointing, very much, to me that we haven't had the K-Mart unit, because if we had the K-Mart unit we could then perhaps make Dr. Park go back to his studies and say, "Look, maybe I was wrong." It doesn't matter that the K-Mart model took twelve or thirteen or fourteen years. Hot fusion took fifty years and hasn't produced one of anything, other than expenditures of money.*

. . .My prediction is, and I'll be more conservative this time to favor Dr. Park a bit, I would say that I would be very surprised if within five years we don't have the K-Mart model. But, I honestly feel that it will come somewhat sooner than that. But, in any event, that's not the important thing. The important thing is that Nature is doing something new that we haven't imagined before. Many scientists, now mounting to thousands in the world, have reproduced various aspects of this. They are endeavoring to try to understand how it works and how to make it practical for humanity. What we have tonight, and I'm glad your listeners have seen this in its gory sadness, is an aging physicist who just can't get it through his head that experiments are more important than *ancient theories.*

Amen to that! ✧✧✧

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Review of a Cold Fusion Theory: Mechanisms of a Disobedient Science

David Moon*

Preliminary Comment

A correction of terms in the theory reviewed here is in order. The intermediate neutrons that were proposed to form in some of the mechanisms, when a proton or deuteron weakly—partially—captures an electron from a metal atom's electron cloud, were originally termed an "unstable mononeutron" (UMN, n*) and "unstable dineutron" (UDN, ^{2}n*) respectively. Later, the terms "hydron" and "heavy hydron" were adopted for these particles.

These new names were given in ignorance of claims by F.J. Mayer and J.R. Reitz of "the class of resonance particles that we [Mayer and Reitz] have called hydrons (p^+e^-, d^+e^- and t^+e^-)." [See *21st Century Science & Technology*, 1991, 4, 4, 4, and "On Very Low Energy Hydrogenic Nuclear Reactions" by Mayer, F.J. and Reitz, J.R. 1991, *Fusion Technology*, November, 367.]

With apologies to Mayer and Reitz—who did not contact me about my duplication—I am replacing "hydron" and "heavy hydron" with "neupron" (n*) and "heavy neupron" (^{2}n*). Similarities between the hydron and neupron might exist.

Introduction

Since the first published article in 1994,[1] the cold fusion theory called "Mechanisms of a Disobedient Science" (MODS) has developed and expanded in its attempt to account for essentially all phenomena from various metal-deuterium methods,[2,3] metal-light hydrogen systems and cavitation devices,[4] sonoluminescence,[5] radioactivity remediation processes[6] and low-energy nuclear transmutation experiments.[7,8]

The working mechanism in the model consists of the formation of p or d chains in the surface layers of the metal lattice, whether loaded by ion bombardment, plasma discharge, gas-phase pressure with heat, or by electrolysis. The p or d chains (strings) oscillate in a free, nearly superconductive manner that allows their collective energy to generate wave pulses along the chain. The lead protons (or deuterons) in a chain enter the volume of a metal atom at a barrier such as a grain boundary. At various stages of invasion into the metal atoms, called windows (see Figure 1), the different nuclear reactions (outlined below) have a chance to occur. Data published by G. Chambers, *et al.* in 1991,[9] in which charged particles were measured coming out of d-loaded titanium film, first suggested that the chains might oscillate at a microwave frequency.

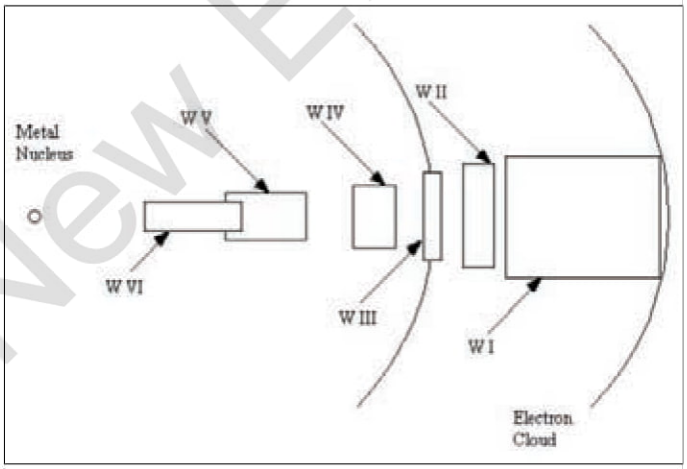

Figure 1. Metal atom windows

In some electrodes, lattice voids or defects just under the surface can collect the p or d chains and wrap them into microplasmas, resulting in various "hot spot" phenomena[10] and surface features such as volcanic eruptions, as found by Matsumoto, Ohmori, and others.

This review of the spectrum of reactions generated by the MODS hypothesis assumes creation of the active site in the electrode or target metal, which will contain chains (linear or circular vortex) of protons or deuterons to interact with metal-atom barriers. Which of the windows in the volume of a metal atom that sees a reaction during invasion of the oscillating chain will generally depend on 1) the length and energy of the chain, 2) the degree of coherence and resonance of the oscillations, and 3) the distance between units (p or d) in the chain.

Nickel-Light Hydrogen

Heat: The primary source of excess heat is proton fusion in Window I—or Window II if reached:

(a) $p + e^- + p \rightarrow d + \nu + 1.442$ *MeV (phonons)*

where ν in this article generically represents neutrinos *i.e.* neutrino or anti-neutrino. The neutrino in (a) carries away minimal energy.

In Ni-H_20 electrolysis, increasing current density generally creates increased loading of H and an increased excess enthalpy. A peak or plateau is reached, however, and beyond several volts of input the power gain drops off exponentially. Dr. Mitchell Swartz refers to the "π-notch" in the graph of Power (out) versus Power (in).[11]

This nickel drop-off may have an explanation from MODS.[7,8] Proton chains that are close-unit—protons spaced closer together—have a greater chance of fusing inside Window I during invasion. At a lower to moderate current density in Ni the active surface layers become fully loaded, giving maximum excess enthalpy for the particular electrode. Beyond this peak power output, increasing current density begins to divide the chains—protons spread farther apart—so that p + p fusion declines. The lead proton in a chain is able to invade into Window II where neuprons form. The neuprons—neutral particles, see below—bring about low cell-heating transmutations of nickel. Therefore, if current density is too high, heat drops off.

Transmutations: If the leading proton in a proton chain that is invading a nickel atom reaches into Window II, without having been intercepted by fusing in Window I, then there is a probability that the proton will weakly—partially—capture an orbital electron to form an unstable neutron, or neupron (n*). Neupron formation is more likely to occur during very low input[12] before loading of H has reached the level needed to make close-unit chains for fusion in Window I, or during higher input beyond the π-notch drop-off, as earlier described.

Several kinds of element transmutations and cold fission reactions can occur when one or more neuprons interact with nickel nuclei. In all cases it has been proposed[7,8] that the accompanying antineutrinos carry most—perhaps 99%—of the reaction energy out of the cell. Thus, massive transmutations are possible with very little excess heat generated.[12] Sample reactions with neuprons are:

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(b-1) ${}^{62}_{28}Ni + n^* \rightarrow {}^{63}_{29}Cu + e^- + \nu$

(b-2) ${}^{64}_{28}Ni + n^* \rightarrow {}^{65}_{29}Cu + e^- + \nu$

(c-1) ${}^{62}_{28}Ni + 2n^* \rightarrow {}^{56}_{26}Fe + 2\left({}^{4}_{2}He\right) + 2(e^- + \nu),\ Q = 3.58\ MeV$

(c-2) ${}^{60}_{28}Ni + 4n^* \rightarrow {}^{56}_{26}Fe + 2\left({}^{4}_{2}He\right) + 2(e^- + \nu),\ Q = 20.44\ MeV$

(d) ${}^{39}_{19}K + n^* \rightarrow {}^{40}_{20}Ca + e^- + \nu$

(measured by R. Bush, R. Notoya, etc. using potassium carbonate electrolyte)

Reactions (b) and (c) have interesting interpretations in the data analyzed by Prof. George Miley after electrolyzing thin nickel film coated on plastic beads.[12] Extensive element transmutations took place with only 0.06 W power input, and about 0.5 W output. [A side note: CETI's demonstration of the Patterson Cell at the 16th Symposium on Fusion Engineering in October 1995, had an identical input of 0.06 W (3 V x 0.02 A), but produced 4.8 W excess—nearly ten times as much. With cell input equal to that of the Miley experiment, comparable loading of H would be assumed, and equal heating would be expected in both cells. However, CETI used beads with multiple layers of Pd and Ni. This has the advantage of providing at least one Pd-Ni interface for p + p fusion, as predicted by the "swimming electron layer" (Miley, Hora) existing at the dynamic metal-metal interfaces, when p chains are made more dynamic by the applied current.]

Among the major new elements were Fe, Ag, Cu, Mg, and Cr, and these were "in concentrations exceeding 2 atom % each, plus a number of additional trace elements." The post-run examination of copper showed deviation from its natural isotope percentages of 69.1% Cu-63 and 30.9% Cu-65, as did most elements. Neutron Activation Analysis (NAA) of a sample of Ni-coated beads after electrolysis measured Cu-63 atom 72.7% and Cu-65 atom 22.8%, within normal experimental error. This gives a ratio of Cu-63/Cu-65 = 3.19. The nickel isotopes as found in nature include 3.66% Ni-62 and 1.16% Ni-64, giving a ratio of Ni-62/Ni-64 = 3.15. Thus, it is implied that reactions (b-1) and (b-2) occur at equal rates, and involve low flux of neuprons.

The "element depth profile" reported by Miley[12] reveals that the "Cu peaks further out in the film," that is, toward the outer surface of the 650-Angstrom nickel film. The MODS theory would predict a lower neupron concentration to form at the metal surface in a spherical bead. Reactions like (b-1) and (b-2) would occur there. In addition, the observation was that "the key elements Ag and Fe peak near the Ni-plastic interface." Reactions (c-1) and (c-2) require somewhat larger neupron fluxes which, in the mild electrolysis experiment, will increase inward through the microsphere.

Indeed, it is believed that a gentle current applied to a thin metal film can assist the proton chains to manufacture, and maintain, a build-up of neuprons in Window II of the nickel atoms. A great variety of fusions and fissions involving nickel are possible, as evidenced by Miley's data.

Strangest among the data in the nickel-coated beads is the production of heavy metals, such as Ag, at the bead core. Apparently, at this depth, neuprons become compressed into a large "polymer of neuprons"—a resonant aggregate of neuprons under confinement near the core. The "swimming electron layer" (SEL) of Miley and Hora stabilizes the mass of neuprons and, in fact, helps assemble them at the core. The quantum state is one of a single large quantum element in which the nickel atoms in the region are an extension of the coherent neupron mass. For example, fifty-eight neuprons situated between two Ni-58 atoms form a "continuum of nucleons" with a mass of 3 x 58 = 174. Other-sized polynuclear resonant masses may form.

The neupron aggregate might encompass five or six nickel atoms, and possibly is related to the kind of "complex nucleus" proposed by Miley (see Miley, G. H. 1999. "Product Characteristics and Energetics in Thin-Film Electrolysis Experiments," *Cold Fusion Times*, 7, 1, 1). A representative reaction from Miley first forms the complex nucleus (X^x - 313) with mass A-313, followed by a bimodal or trimodal fission:

$$23n^* + 5Ni^{58} = X^x - 313 = X^x - 170 + X^x - 104 + X^x - 39$$

Applying this scheme, the MODS theory can offer the following sample reactions:

$$2\left({}^{58}_{28}Ni\right) + 19n^* \rightarrow X^x - 135 \rightarrow {}^{107}_{47}Ag + {}^{24}_{12}Mg + {}^{4}_{2}He + 5(e^- + \nu)$$

Q=118 MeV, mostly anti-neutrinos

$$4\left({}^{58}_{28}Ni\right) + 58n^* \rightarrow X^x - 290 \rightarrow {}^{208}_{82}Pb + {}^{70}_{30}Zn + {}^{12}_{6}C + 6(e^- + \nu)$$

Q=273 MeV, mostly anti-neutrinos

I am grateful to Dr. Miley for the insight provided to account for large-Z transmutation products from nickel.

X-Rays: Reactions such as (b), (c), and (d) eject electrons at probably KeV level, while the anti-neutrinos carry most of the energy to the outside. Soft X-ray spectrums showing some K-alpha and K-beta peaks from nickel, potassium, etc. would be expected.

Tritium: Formation of tritium has been reported by some researchers using Ni-H systems (*e.g.* T.K. Sankaranarayanan *et al.*[13]). Tritium is proposed to form at the inside region of Window II or just into Window III when a deuteron—made from a previous p + p fusion—is propelled into Window II or III, fusing with the next trailing proton in the chain:

(e) $d + e^- + p \rightarrow t + v + 5.47\ MeV$ (phonons)

If the input to the Ni-H_2O electrolytic cell is not too high to begin causing disruption of the proton chains, then reaction (e) and perhaps reaction (f), which reduces tritium, can occur within Window II to III, probably also in Window I.

(f) $t + p \rightarrow {}^{4}He + 19.81\ MeV$ *(phonons)*

Reaction (f) qualifies as the "tritium cleansing mechanism" suggested by T. K. Sankaranarayanan *et al.*[13] in Ni-H_2O electrolysis when they reproducibly observe "that in some cells the tritium data oscillates in a sawtooth fashion over a month or more." Evidently, tritium can leave the active site, then reenter later to convert to helium-4. This up and down behavior of tritium perhaps is related to some property of the lattice active layers that "breathes," that is increases-decreases-increases over time.

Neutrons: Neutrons are occasionally reported coming from Ni-H cells. This surprise finding may have an explanation in the MODS theory.

Nickel electrodes containing straighter proton chains in the surface layers, which can be accomplished with applied magnetic fields around the electrode, may be expected to see the chains invade further into a nickel atom at higher energy of oscillation.

For example, when p + p fusion occurs to make a deuteron in Window I or II, if some of the fusion energy can be constrained to travel along the chain instead of dissipating in all directions through a lattice domain, then the chain might rebound energetically during its next oscillation to propel the just-formed deuteron all the way into Window V. There the deuteron might capture an inner-orbital electron to form a dineutron.[2,3] The dineutron can react with the metal nucleus, yielding a neutron or gamma photons. For example:

(g) ${}^{60}_{28}Ni + {}^{2}n \rightarrow {}^{61}_{28}Ni + n(5.32\ MeV)$

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(h) ${}^{58}_{28}Ni + {}^{2}n \rightarrow {}^{60}_{28}Ni + gammas\ (17.89\ MeV)$

Or fission may occur, *e.g.* Fe-56 + He-4

Earlier reports[14,15] from the Cold Fusion Workshop in Asti, Italy —November 1997—included a paper by Stefano Veronesi on findings of gamma emissions and neutron bursts—a few thousand neutrons/sec—from the Piantelli-Focardi-Habel system, which uses a nickel rod at high temperature, 600°K to 800°K, loaded with hydrogen gas and encircled with a solenoid winding to provide the magnetic constriction, strict alignment, of the proton chains. At high temperature, and with no electric current going through the nickel rod which could jostle the proton chains out of line, greater efficiency of oscillation of the chains results. This allows for further invasion to make dineutrons in Window V.

Another location for dineutron formation, but at a lower probability in most Ni-H cells, is Window II. Here two protons that fuse might form a dineutron by capturing two orbital electrons instead of one:

(i) $p + 2e^- + p \rightarrow {}^2n + 2\nu + 0.93\ MeV\ (phonons)$

If reaction (i) occurs at all in Ni-H_2O electrolysis experiments, it will likely come at maximum input—just before the π–notch drop-off.

Cavitation Reactors

Machines of various sorts that produce intense bubbling in water are claiming over-unity at the multi-kilowatt level. The Hydrosonic Pump™ by James Griggs is one such device (*Infinite Energy*, **1**, 5/6, p. 25). The cavitation bubbles emit flashes of light during each compression and are judged by the MODS theory to behave essentially identical to the bubble mechanism proposed for the well-known phenomenon of sonoluminescence.[5]

The mechanism states that during the supersonic collapse of a cavitation bubble a spiraling plasma of proton chains forms. The plasma expands into the shrinking bubble wall. Protons invade atoms in the wall, mostly oxygen and nitrogen. Orbital electrons weakly captured by the invading protons form neuprons ($p + e^- + E \rightarrow n^* + \nu$). The resulting energy shifts in oxygen, nitrogen, etc. will emit photons of ultraviolet, soft X-rays and visible light.

The E-value in the above reaction represents the sum of the potential energy on the invading proton and the total energy of the orbital electron being partially captured. This value has only been estimated to be 30 or 40 KeV up to 160 or 170 KeV. More than one intermediate resonance state between the electron and proton within the neuprons may exist. Here a median value of E = 80 KeV is used. At that energy, the electron in n* "extends outward" from the proton a distance of 18 fermis. That is, $r = 1.8 \times 10^{-12}$ cm in the relation, $r = Ze^2/E$.

A neuprons approaching an oxygen-16 atom or a nitrogen-14 atom will not likely cause a nuclear change. Instead, n* will release its electron, leaving an exposed proton in the vicinity of the nucleus. As n* approaches, the nitrogen—or oxygen—nucleus sees a neutral particle until n* comes very close. For simplicity, the distance from the N-14 nucleus where n* disengages its electron will be taken as 48 fermis, which is the distance where the Coulomb force between the nitrogen nucleus and the neuprons's electron equals the neuprons's own electrical attractive force on the electron. The exposed proton suddenly experiences a Coulomb potential energy of about 210 KeV and will accelerate with that energy away from the nitrogen nucleus.

The excess energy measured is equal to this acceleration energy minus the input energy used to make n* in the shrinking bubble. The median input of 80 KeV is used. Thus, excess energy = 0.21 MeV – 0.08 MeV = 0.13 MeV.

Certain other assumptions are made in order to estimate the excess power from a cavitation machine. The first assumption is that each flash of blue light emitted from a collapsing bubble contains the reported 10^5 visible photons, generated while forming about 5×10^4 neuprons. (The bubbles are probably air bubbles, which means they contain mostly nitrogen, which emits blue light during quantum energy shifts when the invading protons capture inner electrons to form n*.)

Another assumption is the formation of 150 million repeating bubbles in the highly aerated water (volume of 0.5 liters, or 300 bubbles per cubic millimeter) at an ultrasound rate of 40,000 cycles per second.

Therefore, estimation of the excess power is:

$(1.5 \times 10^8$ bubbles$)(4 \times 10^4$ cycles/sec/bubble$)(5 \times 10^4$ neuprons/cycle$)$
$= 3 \times 10^{17}$ neuprons/sec,

$(3 \times 10^{17}$ neuprons/sec$)(0.13$ MeV/neupron reaction$)$
$= 39 \times 10^{15}$ MeV/sec,

$$\frac{39.0 \times 10^{15}\ MeV/sec}{6.24 \times 10^{12} MeV/sec/W} = 6.25\ kW$$

(Typical output from the Griggs cavitation device, as reported in Mallove, E. F., ed. 1994. *Cold Fusion*, **1**, 2, June, p. 31.)

Excess heat from cavitation machines is non-nuclear, caused by Coulomb acceleration of disintegrating neuprons.

Low energy-yielding nuclear changes can occur in the cavitation machines, however. A neupron might transmute nitrogen-14 to carbon-14: ${}_7N^{14} + n^* \rightarrow {}_6C^{14} + p$. Carbon-14 might also be consumed: ${}_6C^{14} + 2(n^*) \rightarrow {}_8O^{16} + 2(e^- + \nu)$. A thought occurs: If carbon-14 deposited in the fossil records can be changed into oxygen-16 in a natural "transmutation after death" (or "transmutation of dead stuff"), how would that alter the outcome of carbon-dating analyses?

Perhaps the new paradigm of Chemically-Assisted Nuclear Reactions (CANR), or Low-Energy Nuclear Transmutations (LENT), has been throwing a "monkey wrench" into the entire evolutionary-interpreted radionuclide dating methods all along. Could even the Uranium-238 Disintegration Series, which ends at Lead-206, be in jeopardy? The rediscovery of cold fusion by Fleischmann and Pons, in 1989, let the free energy genie out of the bottle. Did it also open a can of worms for the paleontologist?

Heavy Hydrogen Systems

Heat: The principle source of excess heat in D_2 or D_2O cold fusion cells is fusion of deuterium to make helium-4 inside Window I of the metal atom (*e.g.* Pd, Ti):

(j) $d + d \rightarrow {}^4He + 23.85\ MeV\ (phonons)$

In Pd-D_2O electrolysis, increased current density brings accelerated loading of D. But because of internal redistribution of deuterons into the bulk, the surface layers are not accumulating deuterons quickly. A graph of excess enthalpy versus input power will show a more gradual increase in heat output. Full loading of the active surface layers where d chains form, therefore, is delayed and requires a higher current density to reach peak heat. The π-notch drop-off in excess heat will display a "shift to the right," to use the words of Swartz.[11]

Tritium: The delayed loading of the surface layers in palladium to a comparable level with nickel, for example, has an effect on the energy of the oscillations of the d chains. Since the maximum loading is occurring at higher current density, local deuteron chains sometimes will have enough energy to propel further into the Pd atom. If the leading two deuterons in the invading chain reach into Window II before they fuse, they will experience higher Coulomb repulsion from the Pd nucleus. The charge orientation at this point would be: Pd nucleus→n-p → n-p. This head-to-tail encounter between two deuterons in Window II implies a fusion product consisting of npn + p.

It would be expected that the reaction (d + d → t + p + 4.03 MeV) occurring in Window II would leave most of its energy with the lattice.

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occurring in Window II would leave most of its energy with the lattice. The triton and proton are not very energetic in the MODS theory.

Tritium manufacture in Window II is only going to happen when the cell input is increased to near the maximum level just before the π-notch drop-off, where maximum heat per unit input occurs. Above this higher input, the MODS theory predicts that deuteron chains will begin to divide and spread out (similar effect in Ni-H), implying fewer fusions in Windows I and II. Because deuterons are larger than protons—having a longer "reach" of their wave function—the π-notch drop-off may not be as abrupt. Nonetheless, the added entropy in the chains means they can invade into Windows IV to VI at an increasing rate.

In experiments where active sites in the palladium leak deuterium, for example into the bulk or escaping via cracks, measurable excess heat from d-d fusions in Window I will be marginal or absent because the active layers cannot maintain as many close-unit d chains as are needed for significant He-4 production in Window I. However, tritium still might accumulate at rates up to tens of billions per second when the cell input is increased to achieve fusions in Window II, yielding only milliwatts of excess power. At the higher input, d chains begin to spread out, but the small amount of additional loading of d might build a few more chains that will then reach into Window II. Thus, researchers sometimes report that cells apparently void of excess heat suddenly generate bursts of tritium when the input to the cell is cranked up to a level that accomplishes d-d fusion in Window II.

Window IV is another location for tritium formation, and it can occur at higher cell input, especially in plasma discharge experiments (Claytor *et al.*[16]). The mechanism involves the lead deuteron invading into Window IV, trailed by a deuteron reaching into Window II or III. The trailing deuteron weakly captures an orbital electron to make a heavy neupron ($^2n^*$). The leading deuteron then encounters the heavy neupron (*a.k.a.* unstable dineutron, UDN). Low-energy tritium is made because the beta particle (e^-) picks up most of the Q-value:

(k) $d + {}^2n^* \rightarrow t + p + e^- + \nu,\ Q = 4.0\ MeV$

As in Ni-H cells, tritium appearing in Pd-D_2O electrolytic cells often exhibits an increase-decrease behavior. A tritium-consuming reaction can be postulated when the tritium made in Window II or IV—which was born sitting still—remains in the active site (or returns later) to subsequently fuse with a proton in reaction (f), or fuses with another deuteron in the chain inside of Window I or II:

(l) $t + d \rightarrow {}^4H + p + 18.32\ MeV\ (phonons)$
followed by, ${}^4H \rightarrow {}^4He + beta\ (50\ KeV) + \nu$

NOTE: De-excitation of the fused t-d complex inside Window I or II is slow, with energy dissipating in smaller quanta. The proton with its positive charge is more easily expelled than the neutron, leaving a hydrogen-4 nucleus.

Helium-3: Helium-3 detection has been reported from several Pd-D cells, most notably by Arata and Zhang (Osaka University, Japan) using their innovative double structure palladium black cathodes.[17,18] One source of helium-3 in MODS is a p-d fusion in Window I, which occurs between the proton left over from (d + d → t + p) in Window II and another deuteron in the chain:

(m) $p + d \rightarrow {}^3He + 5.49\ MeV\ (phonons)$

Interestingly, helium-3 from reaction (m) appears concurrently with tritium made from d-d fusion in Window II. Arata and Zhang did not find tritium in their Pd-black electrodes, but they did get helium-3. Therefore, either the tritium formed in Window II and remained in the active layers to be consumed in reaction (f) or reaction (l), or the He-3 came from p-d fusions in which the proton was a by-product from metal transmutations involving heavy neuprons in Window II [see reactions (r) and (s) below]; or yet another possibility for their He-3 is reaction (q) involving lithium-6.

Not to be outdone by tritium consumption already described, helium-3 consumption might actually occur when the tritium made from d-d fusion in Window II remains in the chain, along with the He-3 from reaction (m), to fuse into Li-6 in Window I:

(n) $t + {}^3He \rightarrow {}^6Li + 15.8\ MeV\ (phonons)$

The net sum of these reactions is:

$$\begin{array}{l} d + d \rightarrow t + p + 4.03\ MeV \\ p + d \rightarrow {}^3He + 5.49\ MeV \\ \underline{t + {}^3He \rightarrow {}^6Li + 15.80\ MeV} \\ d + d + d \rightarrow {}^6Li + 25.32\ MeV \end{array}$$

Another reaction that removes He-3 might take place inside Window I:

(o) $^3He + d \rightarrow {}^4He + p + 18.35\ MeV\ (phonons)$

Besides reaction (n), lithium-6 might be made by fusing He-4 made in Window I with another deuteron in the chain:

(p) $^4He + d \rightarrow {}^6Li + 1.47\ MeV$ (phonons)

Reaction (p) provides the Arata-Zhang cell a way to make Li-6 that is unassociated with tritium in reaction (n), since they report no tritium. If Li-6 accumulates at the regions of manufacture in the active site (grain boundaries, lattice voids) then it would become a potential raw material to make some of their helium-3:[19]

(q) $^6Li + n^* \rightarrow {}^4He + {}^3He + e^- + \nu\ (4.0\ MeV)$

The neuprons (n*) are created from protons in the active site, put there by transmutation reactions such as reactions (r) and (s).

Any gas-phase Pd-D electrode, or electrolytic cell having close-to-zero background lithium, might contain new lithium atoms after a very positive heat run.

More comments about the Arata-Zhang Cell: The A-Z cell had a fairly high electrical input—up to approximately 135 watts input, giving about 120 watts excess. (See Figure 12, p. 31, reference 18.) The cell voltage ranged from 15-30 volts.

In the MODS model, it is expected that a Pd-D electrode running at higher input power would at some point be able to occasionally propel fully loaded d chains into Window II where the reaction (d+d → t+p) occurs. But the A-Z quadrapole mass spectrometer data had no clear tritium signature. The nature of their palladium electrode construction is likely the reason.

The double structured Pd cathode, filled with some three grams of Pd-black, consists of particles about forty nanometers (100 atoms) thick, or 8300 square meters of surface area per gram of Pd-black.[18] "It was practically all surface," wrote Mike Carrell. Therefore, with no bulk Pd to deplete the surface layers of deuterons, the layers achieved "overloading." Consequently, the two leading deuterons in an invading d chain could not reach Window II to produce tritium because they were "too close together" during invasion into the Pd atoms' electron cloud. So they suffered premature d-d fusion in Window I, and an increased rate of reaction (p) to make Li-6, which is postulated to be a major source of He-3 in reaction (q).

Another factor hindering tritium formation was that their electrical input—up to about 4.5 A—was spread over a very large surface area. On average, there was enough local input to propel usually one but not two deuterons into Window II—if d-d fusion in Window I did not occur first. So they could make heavy neuprons in Window II for reactions such as (r) and (s), which create protons to make their helium-3 in reaction (q) and reaction (m).

The performance of these reactions in the A-Z Pd-black electrode is unique in that the tiny palladium grains serve as an

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ideal template for many deuteron chains to wrap themselves into spiraling plasma vortices. As they do, d-d fusions making helium-4 begin to occur in the inner region of the plasma vortex, energizing the plasma and drawing in more deuteron chains. At the outer region of the vortex, however, the deuteron chains are "stretched out" (not close-unit). Here, d-d fusions are replaced with heavy neupron production in Window II of Pd atoms. Transmutation reactions, such as (r) and (s) below, start making protons which, if held in by the spinning plasma, will create a layer of neuprons around the core of the plasma vortex. Meanwhile, fusions in the core region have been building Li-6 in reaction (p). Eventually, the core expands. Lithium-6 nuclei pass through the outer layer of neuprons. A sudden increased rate of reaction (q) adds helium-3 (and helium-4) to the accumulating nuclear ash in the Arata-Zhang cell.

X-Rays: When tritium is made in Window II, a possible by-product is radiation in the form of ultraviolet and soft X-rays, easily hidden. Tritium produced by reaction (k) in Window IV, however, generates MeV-level beta particles (e^-), as do many of the metal transmutations given below, *e.g.* reactions (r) and (s). These energetic electrons coming out of heavy neupron reactions produce a broad spectrum of bremsstrahlung emissions which should contain some hard X-rays up to perhaps 100-200 KeV. However, excess heat production in Windows I and II does not require externally detectable X-rays.

Transmutations: Deuteron chains in the active sites that have formed well enough to invade metal atoms, but have deuterons spaced too far apart to guarantee fusion in Window I, may yet reach into Window II and convert the lead deuteron into a heavy neupron ($^2n^*$). A great variety of transmutation and isotope shifts are brought about by the heavy neupron. A few samples are:

(r)
$$^{105}_{46}Pd + {}^2n^* \rightarrow {}^{106}_{46}Pd + p + e^- + \nu$$

(s)
$$^{108}_{46}Pd + {}^2n^* \rightarrow {}^{109}_{46}Pd + p + e^- + \nu$$
$$Then,\ {}^{109}_{46}Pd \rightarrow {}^{109}_{47}Ag + beta + \nu + gamma,\ t_{1/2} = 13.5\ h$$

(t)
$$^{50}_{22}Ti + {}^2n^* \rightarrow {}^{52}_{23}V + e^- + \nu$$
$$Then,\ {}^{52}_{23}V \rightarrow {}^{52}_{24}Cr + beta\ (2.47\,MeV) + \nu + gamma\ (1.43\,MeV),\ t_{1/2} = 3.75\ m$$

(u)
$$^{105}_{46}Pd + {}^2n^* \rightarrow {}^{103}_{45}Rh + {}^4_2He + e^- + \nu$$

In reactions (r) and (s) the emitted electrons accelerate at MeV energy. An X-ray spectrum is created during thermalization of these electrons. Some hard X-rays are detectable outside of the cell, but part of the radiation is reabsorbed internally, contributing to any excess heat.

Reactions (t) and (u) experience a major energy loss as the anti-neutrino is predicted to pick up most of the Q-value for the reaction and carry it out of the cell.[7,8] Gamma radiation from some new isotopes is often detected from spent palladium or titanium electrodes using D_2 or D_2O.

A more unusual kind of cold fission is postulated by the MODS theory to happen within plasma vortices that have developed within subsurface lattice voids. The microplasmas contain a concentration of swirling deuteron chains. Multimodal fissions occur, caused by a very high flux of heavy neuprons that formed, and generally retain only a minor portion of the released energy due to antineutrino loss. (However, the plasma ball can sometimes create fusions in Window I rapidly enough to explode in a volcanic-like fashion.) One example is:

$$(v)\ {}^{105}_{46}Pd + 12({}^2n^*) \rightarrow {}^{57}_{26}Fe + {}^{16}_{8}O + {}^{12}_{6}C + 4({}^4_2He) + 3({}^6_2He) + 3({}^3_1H) + {}^1_1H + 12(e^- + \nu)$$

$$Q = 19.4\ MeV,\ mostly\ anti\text{-}neutrinos.$$
$$Then,\ {}^6_2He \rightarrow {}^6_3Li + beta + \nu,\ t_{1/2} = 0.8\ sec$$

Reaction (v) was offered[8] as an explanation for some of the data obtained by Matsumoto and Kurokawa during electrolysis of heavy water at a palladium cathode.[20] Their mass spectrograph of discharged gas from the Pd rod initially (at 175°C during stepped heating) traced a large peak at mass-6, which they assigned to Li-6, He-6, and/or D_3. This peak disappeared one hour later, at 775°C. They also had a peak at mass-3, which was attributed to tritium and/or helium-3.

It should be noted that reaction (v) and ones like it are believed to occur primarily in the middle region of a subsurface microplasma. Reactions (r) and (s), which generate protons then possibly neuprons for reaction (q) to make He-3, are common to the plasma's "thinner" outer region. If d-d fusions at the plasma's inner region finally occur in Window I, then the Li-6 (and other accumulated products) can expand, perhaps explode, into the outer neupron layer to make He-3 in reaction (q). Otherwise, helium-3 may not appear as a product. It depends on the local deuteron concentration forming in the subsurface lattice void.

Although reaction (v) makes tritium, the tritium does not accumulate at significant levels in the electrode. Tritium, when made, appears in Windows II and IV at or very near the metal surface, and generally escapes to the electrolyte or the gas phase.

Neutrons: It is by now an accepted characteristic of cold fusion that neutron emissions are chaotic and unpredictable. Heat production itself is considered aneutronic. Heat comes mostly from fusions in Windows I and II. Neither Window involves neutrons. Neutron emissions, when observed, may occur randomly at low level, or suddenly in bursts of 10^2 to 10^7n/second. Neutrons have been measured from heavy water electrolysis, pressurized gas cells, and low or high voltage gas discharge experiments. Neutron energy spectra give the conventional 2.45 MeV, bands at 2.5 to 7.0 MeV, or even higher energies—up to 17 MeV neutrons detected in glow discharge cells by Kucherov *et al.* in 1993.[21]

MODS can produce neutrons in several ways. First, reactions between metal nuclei and heavy neuprons from Window II that eject the p+e^- combination, as in reactions (r) and (s) above, can occasionally reabsorb the 0.783 MeV needed to convert (p+e^-→n). For example, the Q-value for reaction (r) is 7.323 MeV. Thus, when p+e^- is converted to a neutron, the energy release is 7.323 – 0.783 = 6.54 MeV:

$$(w)\ {}^{105}Pd + {}^2n^* \rightarrow {}^{106}Pd\ (0.04\ MeV) + n\ (6.50\ MeV)$$

For all Pd isotopes, neutrons from reaction (w) range from 2.5 to 6.5 MeV. The neutrons have a low rate. A very rough estimate is 10^{-12} of heavy neupron events. They are usually random, single neutron events, or very low bursts. Since these neutrons originate from invasion of d chains into Window II, they can occur during low to moderate power input to a Pd-D cell.

Chains of deuterons that reach into Window III—the innermost "edge" of the metal atom's electron cloud—will, upon recoil from the Coulomb force of the metal nucleus, experience partial electron screening between deuterons—enough to allow for d-d fusion (*if sufficiently close together*) but not enough electron density to dissipate much of the fusion energy. In the helium-3 branch, neutrons at 2.45 MeV and somewhat lower are created. Window III is very narrow, so the neutrons are usually singular, or not at all. To reach Window III, higher input to the cell is generally required.

However, even at modest cell input, an electrode might emit neutrons from Window III. This would happen under special, undefined conditions in the active site when there develops a "local focusing of excess energy." MODS predicts that active

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sites in electrodes are more ordered than disordered.[3] A particular d chain could momentarily borrow energy from neighboring coherent oscillators to suddenly achieve invasion into a metal atom much beyond its average extent of penetration for the given voltage and current density.

A burst of excess heat produced at an active spot in the deuterated electrode also might increase the extent of invasion of the d chains beyond what is provided for by the cell input power. That may explain why in some experiments researchers have noticed neutron bursts (from Windows III and V) and/or tritium bursts (from Window II or IV) following a heat burst.

Neutron emissions also appear when d chains invade into Window V where dineutrons are made.[3] In a Pd atom the middle of Window V is located 246 fermis from the nucleus (first Bohr orbit is 1180 fermis). In Ti, Window V is 123 fermis while the first Bohr orbit is 2520 fermis from the nucleus. The collective energy of an oscillating d chain must focus 269 KeV on the lead deuteron in a wave pulse in order to reach Window V in Pd, and 258 KeV to reach into Ti. Even at thermal energy (0.025 eV), a chain consisting of ten million deuterons, which would be about 500 to 1000 microns in length, could nearly reach Window V in a titanium or palladium atom.

In fact, evidence for the possible assembly of long d chains at background energy came in 1989. Scaramuzzi in Italy and Menlove at LANL independently performed similar experiments[22] in which pressurized deuterium-gas chambers with titanium chips were first cooled to the temperature of liquid nitrogen (-196°C). When the sample was allowed to warm, neutron bursts of two to ten neutrons and up to three hundred neutrons were detected during 100-microsecond durations. The bursts started at –30°C during warm-up.

A number of factors might account for these neutron emissions from very cold titanium, including possible cracking of the lattice or some other phase change at -30°C during warming. In MODS, formation of deuteron (or proton) chains is actually favored by a decrease in the entropy of the deuterium-loaded lattice.[4] Therefore, at the temperature of liquid nitrogen, the d chains probably were longer and straighter. Energetic wave pulses in the d chains might have been triggered by a kind of "lattice quake" (Arata[17,18]) that occurred suddenly during a phase change or cracking at -30°C.[22] Enough energy may have focused in the chains to reach Window V to make dineutrons, or at least Window I for d-d fusion. Scaramuzzi also reported tritium from his D/Ti/Liquid Nitrogen experiments in 1990 (p. 227 in Reference 22).

In active cells with higher input, the d chains possess energy above thermal. If d-d fusions are energizing the chains, that is, if some (3%?) quantum part of the d-d fusion energy actually travels along the chains (*e.g.* 24 MeV x 3% = 720 KeV in a chain), then the generated wave pulse can propel the lead deuteron into Window V of a metal atom. Of the ~700 KeV of energy in such a wave, 258 KeV must focus on the lead deuteron invading a titanium atom, and could explain the Scaramuzzi and Menlove results.

Window V is more easily reached by invading deuterons at the high voltage associated with gas-discharge experiments. Higher neutron fluxes (10^7 n/sec) are often reported.[21] It is believed that any microwave component in the spectrum of electromagnetic "noise" from a discharge might resonate with the frequency of the d-chain oscillations. Similarly during ion-bombardment experiments, any microwave flux attending the ion beam will enhance chain oscillations to propel a deuteron all the way into Window VI where charged particles are made.[9]

Normally it would be expected that neutrons from Window V would also come from the glow-discharge cells operated by Claytor *et al.*[16] at LANL. They produce large amounts of tritium (10^{11}/hr.) but see almost no neutrons. Reaction (k), which makes their tritium in Window IV, yields an estimated 10^{-12} neutron/tritium. But neutrons from Windows III and V are not made. The d chains are not close-unit and are too short to reach these Windows. High current density is the reason.

Typically, the Claytor group uses very thin (100-250 micron) palladium wire cathodes positioned perpendicular to a thin palladium plate as the anode.[16] Applied voltage is up to 2500 V, with up to five amps of current, giving a very high current density in the wire cathode—on the order of 20 amps per square centimeter, in a 3-centimeter-long wire.

To reach Window V in Pd, 270 KeV of a d chain's collective energy must focus on the leading deuteron in a wave pulse entering the atom, in order to make dineutrons. Apparently, only short chains containing, at most, a few hundred deuterons can form in the Claytor cell midst an extremely high current density, which tends to divide the chains.

When the leading deuteron in a chain enters Window V, its excited energy state creates the condition in which an inner-orbital electron of the metal atom can be captured to convert the deuteron to a dineutron.[3]

After forming, a dineutron reacts with the metal nucleus generally in one of two ways. One kind of reaction produces a singular neutron emission. In titanium samples, these neutrons come out with energy between 3.8 MeV and 9.0 MeV from all titanium isotopes. In palladium cells, the range is 3 to 7 MeV:

(x) $^{105}Pd + {}^{2}n \rightarrow {}^{106}Pd$ (0.04 *MeV*) + *n* (7.01 *MeV*)

(y) $^{110}Pd + {}^{2}n \rightarrow {}^{111m}Pd$ (0.04 *MeV*) + *n* (3.03 *MeV*)

A bimodal fission of the metal nucleus, or ejection of an alpha-particle, can occur when the entire dineutron brings "double excitation" to the nucleus. For example:

(z) $^{48}_{22}Ti + {}^{2}n \rightarrow {}^{46}_{20}Ca + {}^{4}_{2}He + 5.87\ MeV$

Charged Particles: Energetic charged particles are generated from Pd or Ti targets when the deuteron chains invade into Window VI of the metal atoms. The same conditions that allowed for dineutron activity in Window V, such as high voltage or incidental resonating electromagnetic fluxes (as in gas-discharge and ion-bombardment), might also activate Window VI. For example, Kucherov *et al.*, in glow-discharge experiments with palladium in deuterium gas,[21] recorded neutron fluxes with intensity up to 10^7/sec (Window V) and charged particles at a maximum of 10^6/sec (Window VI), among other nuclear signatures and excess heat from Windows I to IV.

Production of charged particles occurs when the deuteron in Window VI donates its neutron to the metal nucleus, rejecting the proton at MeV energy.[23] Sequential fusions between the fast proton and trailing deuterons in the chain sometimes occur if the chain is highly energized and has close-unit deuterons. Much similar data have accumulated from charged particle experiments, suggesting a common mechanism. Both palladium and titanium have charged-particle data in the literature. Examples given below are for ion-bombardment experiments using titanium targets.[9,24]

(aa) $^{48}Ti + d \rightarrow {}^{49}Ti$ (0.12 *MeV*) + *p* (5.80 *MeV*)

The 5.8 MeV proton could immediately react with a trailing deuteron in the chain to produce fast tritons or He-3 nuclei:

(bb-1) *p* (5.8 *MeV*) + *d* → *t* (5.8 *MeV*) + *beta*$^+$ (5.47 *MeV*)** + ν
**Includes masses of beta$^+$ and e$^-$ which immediately annihilate.

(bb-2) *p* (5.8 MeV) + *d* → ^3He (5.8 *MeV*) + *gamma* (5.49 *MeV*)

The value of 5.8 MeV is a median energy. The triton can range from 5.45 MeV (positron and neutrino ejected straight forward) to 6.15 MeV (when ejected straight backward). Nearly the same

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energy range occurs for He-3. However, there is a good chance the 5.8 MeV proton will collide sequentially with the trailing deuteron *inside the electron cloud*, after the deuteron rebounds back from the nuclear Coulomb force. Then the mass of the electron cloud (actually, a whole domain of clouds) takes up the momentum of the Q-release, recoiling a momentum change to the fast He-3 or triton.[25] This greatly reduces the number and energies of the gamma emissions.

During D-ion bombardment on Ti targets at the U.S. Naval Research Laboratory[9] an energy peak of 4.99 MeV for charged particles appeared in one experiment. The researchers estimated that this peak was mostly from tritons created with a starting kinetic energy of 5.38 to 6.0 MeV. The MODS prediction (5.45 to 6.15 MeV) is very close to the NRL conclusion.

Kasagi and Ishii (Tohoku University, Japan) bombarded highly deuterated titanium with 150 KeV deuterons.[24] They found that when the loading ratio D/Ti exceeded 1.2, protons were coming out at energies between 12.5 MeV and 17 MeV. These protons would result when He-3 from reaction (bb-2) fuses sequentially with yet another deuteron at the high loading. (The Q-value for He-3 + d fusion is 18.35 MeV):

$$\text{(cc)}\quad {}^{3}He\ (at\ 5.8\ MeV,\ median) + d \rightarrow \left[{}^{5}Li\right]\ (5.8 + 18.35 = 24.15\ MeV) \rightarrow {}^{4}He\ (e.g.\ 7.15\ MeV) + p\ (e.g.\ 17\ MeV)$$

Generally, if the proton energies in Kasagi's experiment range from 12.5 to 17 MeV, the He-4 should be measured between about 7 MeV and 11.5 MeV. Energetic alpha-particles with such energies have been reported by several experimenters.

Finally, any tritons from reaction (bb-1) will possibly create high-energy neutrons by a sequential collision with another deuteron in the chain (where Q = 17.6 MeV):

$$\text{(dd)}\quad t\ (at\ 5.8\ MeV,\ median) + d \rightarrow \left[{}^{5}He\right]\ (5.8 + 17.6 = 23.4\ MeV) \rightarrow {}^{4}He\ (e.g.\ 6.4\ MeV) + n\ (e.g.\ 17\ MeV)$$

Reaction (dd) in palladium would give similar energies as in titanium, and could account for the 17 MeV neutrons recorded by Kucherov *et al.* in glow-discharge at a palladium cathode.[21]

Les Gets More: Dr. Les Case of Fusion Power, Inc. in Greenland, New Hampshire, presented performance results of his new invention, which accomplishes catalytic fusion of deuterium into helium-4 using only "thermal input," at ICCF-7 in Vancouver, Canada in April 1998. Case's abstract: "Gaseous D_2 is contacted with a supported metallic catalyst at super-atmospheric pressure, and about 130 to 300°C. The catalyst is a platinum-group metal, at about ½% to 1% by weight, on activated carbon. Pd, Pt, Ir, and Rh all work . . . (Pd is preferred) . . . This fusion process does not produce neutrons, helium-3, tritium (or, presumably, hydrogen), but instead produces only helium-4 [at 100 ppm collected in the gas phase]."[26]

The Case device manages to activate Window I exclusively: D+D = He-4 + 23.85 MeV (lattice). Simple temperature stimulation of deuteron chains in the Pd/activated carbon surface results in the chains invading only into Window I. I suspect he also produces Li-6 in reaction (p). But the leading deuteron in a chain does not invade into Window II to make heavy neuprons which could, if made, generate H(protons) in reactions like (r) and (s), which then would create some He-3 in reactions (m) and (q). All of these reactions are apparently avoided in Case's catalytic fusion reactor. He can concentrate on stand-alone excess heat in Window I.

The Ohmori-Mizuno Effect

In the field of cold fusion, we now have the very authoritative under-water "plasma electrolysis"(term from P. Kanarev) or plasma discharge at a carbon or tungsten cathode that triggers an incandescent glow—with about 160V and several amps of current—at the cathode and surrounding vapor sheath. Liberal amounts of ferromagnetic elements, especially iron, and other elements are produced.

In the case of plasma-discharge electrolysis using carbon rods in hot aqueous alkali-metal electrolyte (*e.g.* by Ransford[27] see also Reference 28), and in the Ohmori-Mizuno experiments with tungsten cathode,[29] plenty of excess heat was observed. Ohmori reported 183 W excess power from a very small tungsten foil, while Ransford saw "a few hundred watts of excess thermal energy" from his carbon-rod cells.

The LENT Reactor from the Cincinnati Group[30] is not entirely related to the plasma electrolysis devices, but will be discussed here for comparison. Although it is difficult to make any fair generalizations, I believe the three high-voltage electrolysis experiments—Ransford's, Ohmori-Mizuno's, and CG's LENT Reactor—have interesting performances that may be related to their respective applied current densities. It is proposed that the mechanisms at work in these devices include, at various levels, both the MODS model using neupron particles and the Plasma-Injected Transmutation (PIT) theory[31] which utilizes high-density charge clusters (HDCC) as the carrier for fusing nuclei.

LENT Reactor: Large quantities, in tenths of grams, of thorium—as thorium nitrate electrolyte—are transmuted to lower elements, mostly iron, titanium, and copper, and perhaps higher elements such as protactinium. Electrolysis demonstration experiments can show appreciable effects in less than one hour. A zirconium cylinder has centered in it a zirconium disk, about 2.54 cm diameter, which is apparently about 50% immersed in the electrolyte. In one thirty-minute run,[30] the AC into the cell started from 1.94 A at T=0 minutes, peaked at 8.25 A at T= 9 minutes, then settled to 1.4 A at T=17 minutes. The average current from T=0 to T=17 minutes was 3.2 A.

In a replicate experiment using the LENT-1 Reactor at Trenergy, Inc., Hal Fox reported[32] that the electrolyte temperature, which started at 70°F, stabilized at 350°F +/- 50°F after about fifteen minutes, and that "it is during this time period—the first half of thirty-minute processing—that the major portion of nuclear reactions take place." This was his preliminary hypothesis.

Therefore, using the average current of 3.2 A through the zirconium disk, of which about 5.7 cm^2 of the surface area (50% x 11.4 cm^2, presumed $^1/_{16}$ inch thick disk) is immersed in the electrolyte, the current density is estimated at 0.56 amp per square centimeter. It is my guess the electric environment on the zirconium surface is not optimal for producing large numbers of charge clusters. The current density is a little too low to effectively generate large numbers of HDCC's to facilitate nuclear reactions. (The exception occurs during peak currents, for example at T = 9 minutes when current density is 1.44 amps per square centimeter.) Such reactions should produce generous excess heat, and the amount of heat should correspond to that expected from transmuting 0.1 gram of thorium—approximately 5,000 MJ. I understand little excess heat appears in the LENT Reactor. On the other hand, the surface of the Zr electrodes show pitting, suggesting explosive events occur.

One theory, to explain the lack of heat production, states that the exothermic nuclear reactions are balanced by endothermic ones. Another more speculative idea is prefaced with a comment by Hal Fox: "The dissolution of a charge cluster is an abrupt explosive-type reaction involving billions of electrons and produces a sharp electromagnetic pulse (EMP) which can easily be picked up on a transistor radio tuned off-station on the AM band. It is likely that this type of EMP will affect instrumentation connected to or near the experiment."[33] If HDCC's themselves carry the fusion energy after impact, might a significant portion of that energy transmit out of the cell by means of a high-amplitude EMP? The LENT Reactor or

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the Ohmori-Mizuno tungsten cathode performing as a radio transmitter? And broadcasting its own "Cold Fusion News"?

The other mechanism uses high fluxes of neuprons generated in microplasmas of swirling proton chains at the electrode surface.[6] Multimodal fissions of thorium occur, typified in reaction (v) above and reaction (ee) below. Most of the fission energy is lost to the outside by escaping anti-neutrinos. Also, MODS would normally predict some proton-proton fusion inside Windows I and II of the metal atoms, yielding excess heat at some level. Evidently these fusions are less likely to occur on a zirconium electrode in a concentrated thorium environment. Too few protons are absorbed into the Zr surface.

Ohmori-Mizuno Cell: "Strong heat evolution, enough to incandesce the electrode, was observed by applying a high electric power. The excess energy amounts to 183 W, which is 2.6 times the input power . . . During the electrolysis, considerable amounts of new elements, *i.e.* Pb, Fe, Ni, Cr, and C, were produced. The distributions of Fe, Cr, and C on/in the electrode were overlapped. The isotopic distribution of Pb deviated greatly from the natural isotopic abundance."[29]

Input to the Ohmori-Mizuno cell was 112 W (0.7 A x 160 V), for a current density of 1.4 A/cm^2, roughly 2.5 times the LENT Reactor, and in excess of that used up in the conventional hydrogen gas evolution. Thus, it seems likely that the excessive electric field could generate a flux of HDCC's to bring about transmutation of tungsten to lead in reactions (ff) to (ii) below. An oxygen-16 nucleus plus proton-electron pairs riding the charge clusters bang into the tungsten atoms to cause fusion, with the Q-value carried away by the cluster itself. (Some energy might be transported by the intense RF electromagnetic waves detected by the researchers.) It is noted that reaction (ff) is endothermic and probably does not occur. In fact, Pb-204 was not detected. The data revealed that the tungsten surface converted to 1% Pb after plasma electrolysis, with abundances of Pb-206 (38.5%), Pb-207 (55.0%) and Pb-208 (6.5%).

However, an exothermic reaction making Pb-204 can be written using W-184: ${}_{74}W^{184} + {}_{8}O^{16} + 4(p+e^-) = {}_{82}Pb^{204} + Q + 4\nu$, where Q = 3.9 MeV. Although it is interesting that these reactions using W-186 exclude making Pb-204 in reaction (ff), a reason to prefer reacting W-186 over W-184 is not understood. If the reaction scheme is valid, then possibly a small amount of Pb-204 was made on the surface of the tungsten cathode, and was at the limit of detectability. Moreover, Pb-204 is not a "favored" isotope, at only 1.4% natural abundance. LENT reactions have time to select their product isotopes.

Meanwhile, the MODS mechanisms also are occurring. Vortices of plasma protons just under the electrode surface generate high fluxes of neuprons in Window II of the tungsten atoms to cause fission of tungsten, as in reaction (ee). In addition, p-p fusions in Window I of tungsten atoms would contribute to the large excess enthalpy. Crater-like formations were produced on the tungsten surface.

(ee) $${}^{184}_{74}W + 28n^{*} \rightarrow {}^{56}_{26}Fe + {}^{52}_{24}Cr + 2\left({}^{16}_{8}O\right) + 2\left({}^{12}_{6}C\right) + 6\left({}^{4}_{2}He\right) + 12\left({}^{2}_{1}H\right) + 28(e^{+} + \nu)$$ very low cell-heating reaction.

(ff) $${}^{186}_{74}W + {}^{16}_{8}O + 2(p + e^-) \rightarrow {}^{204}_{82}Pb + Q(cluster) + 2\nu, \quad Q = -7.48\ MeV$$

(gg) $${}^{186}_{74}W + {}^{16}_{8}O + 4(p + e^-) \rightarrow {}^{206}_{82}Pb + Q(cluster) + 4\nu, \quad Q = 5.76\ MeV$$

(hh) $${}^{186}_{74}W + {}^{16}_{8}O + 5(p + e^-) \rightarrow {}^{207}_{82}Pb + Q(cluster) + 5\nu, \quad Q = 11.71\ MeV$$

(ii) $${}^{186}_{74}W + {}^{16}_{8}O + 6(p + e^-) \rightarrow {}^{208}_{82}Pb + Q(cluster) + 6\nu, \quad Q = 18.30\ MeV$$

Some Q-energy is assumed to be carried away by neutrinos, ν.

Ransford Experiment: In a series of experiments replicating the Ohmori-Mizuno work by H.E. "Chip" Ransford at Nova Resources Group in Denver, Colorado, cells with either tungsten or carbon-rod cathodes in hot aqueous potassium (or sodium) carbonate generated large amounts of excess heat—and the characteristic incandescent glow.[27] Cell input generally was 130 to 165 volts DC at 4 to 7 amps. With carbon rods (6 mm diameter, 2 cm length), a large current density (1 to 1.6 A/cm^2) resulted. HDCC's probably were generated, and would bring about carbon-oxygen fusions to produce the abundance of detected elements: Cr, Fe, and Ni. Large conversion rates of potassium to calcium also occurred. One of several possible reactions is:

(jj) $$2\left({}^{12}_{6}C\right) + 2\left({}^{16}_{8}O\right) + 2(p + e^-) \rightarrow {}^{50}_{24}Cr + 2\left({}^{4}_{2}He\right) + 2\nu \quad Q = 50.5\ MeV$$

Other types of HDCC-induced fusions in carbon-rod experiments would involve the minor oxygen-18 isotope (0.2% isotopic abundance):

(kk) $$3\left({}^{12}_{6}C\right) + {}^{16}_{8}O + {}^{18}_{8}O \rightarrow {}^{56}_{26}Fe + 2\left({}^{4}_{2}He\right) + 2\left({}^{3}_{2}He\right) \quad Q = 20.37\ MeV$$

Could fusions such as reaction (kk) occur deep under the Earth's surface—and be a source of helium-3? If so, what kind of thermal and electrical effects deep in the Earth help bring about these plasma-injected transmutations?[31]

Copper-65 Where Are You?

Drastic and dramatic isotope shifts of some elements produced in cold fusion cathodes were recorded by Mizuno, Ohmori, and Enyo.[34] Their cell used a high purity Pd rod as cathode, Pt plate anode, in heavy water with lithium hydroxide electrolyte. They electrolyzed at high pressure, high temperature, and high current density for one month. The authors state: "Current density ranged from 0.2 to 0.6 A/cm^2. Different isotope distributions were obtained depending on the current density."

Many new elements showed large isotope deviations. Unique among their data was the formation of 100% Cu-63 (normal is 69%) with no detectable Cu-65 peak (normal is 31%). It is suggested that the many transmutations of Pd and Pt (electroplated onto Pd) can be explained using both heavy neuprons from the MODS model, and HDCC's from the PIT concept. The PIT reactions are lower rate, limited by the applied current density.

To explain the unusual copper, it is proposed that a series of reactions occur. First, a multimodal fission of Pd, as in reaction (v) above, favors the production of metallic daughter nuclei only as large as iron and smaller. The reason for this particular fission outcome is not yet understood. Iron-56 and 57 apparently dominate. Iron-58 (natural abundance 0.31%) is absent. If Fe-58 were formed in reaction (v), Cu-65 could be produced in reaction (ll) below, but it is not.

Reactions (ll) and (mm) occur when HDCC's carrying Li, O, and D from the electrolyte strike iron nuclei:

(ll) $${}^{56}_{26}Fe + {}^{7}_{3}Li \rightarrow {}^{63}_{29}Cu + Q\ (on\ cluster) \quad Q = 19.88\ MeV$$

(mm) $${}^{57}_{26}Fe + {}^{6}_{3}Li \rightarrow {}^{63}_{29}Cu + Q\ (on\ cluster) \quad Q = 19.5\ MeV$$

Elements beyond Cu such as Zn, Ga, As, and Br, which are among many new elements detected by the Ohmori group, result when multiple ions of Li, O, and D on charge clusters fuse with Fe or Cr, etc.

However, since current density has already predicted that HDCC's forming on Mizuno's Pd electrode are low rate and cannot be responsible for all of the Cu-63 (and other elements), an alternate reaction uses heavy neuprons. Anti-neutrinos extract

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energy, so that more transmutation than heat might appear:

$_{26}Fe^{57} + 3(^2n^*) = {}_{29}Cu^{63} + 3(e + v)$.

Heavy neuprons from the MODS model can interact with iron from reaction (v) to form elements like Co, Ni, Cu-63, and Zn. These reactions retain only a portion of the Q-value when the deuteron in $^2n^*$ is completely added to iron. Anti-neutrinos transport energy from the cell. Two examples are:

$$\text{(nn)}\quad {}^{57}_{26}Fe + {}^{2}_{1}H \rightarrow {}^{59}_{27}Co + {}^{2}_{1}H \rightarrow {}^{61}_{28}Ni + {}^{2}_{1}H \rightarrow {}^{63}_{29}Cu$$

$$\text{(oo)}\quad {}^{56}_{26}Fe + 4\left({}^{2}_{1}H\right) \rightarrow {}^{64}_{30}Zn$$

Xenon is peculiar in the Ohmori data since it was abundant and showed radical departure from normal isotope ratios, especially Xe-136 which went from 8.9% natural to about 25%.

Xenon may have two kinds of sources: 1) fission of platinum using high fluxes of heavy neuprons formed in the plasma vortices of d chains, and 2) fusion with palladium using Li, O, D, etc. riding charge clusters. Respective sample reactions are:

$$\text{(pp)}\quad {}^{194}_{78}Pt + 13\,({}^{2}n^*) \rightarrow {}^{136}_{54}Xe + {}^{36}_{16}S + {}^{16}_{8}O + {}^{10}_{5}B + 3\left({}^{6}_{2}He\right) + {}^{4}_{2}He + 13\left(e^- + v\right)$$

Q = 190.5 MeV, mostly carried by antineutrinos

$$\text{(qq)}\quad {}^{105}_{46}Pd + {}^{16}_{8}O + 5\left({}^{2}_{1}H + e^-\right) \rightarrow {}^{131}_{54}Xe + Q\,(cluster) + 5\,v$$

Q = 60.92 MeV

$$or, \rightarrow {}^{127}_{52}Te + {}^{4}_{2}He$$

Q = 58.38 MeV

$${}^{127}_{52}Te \rightarrow {}^{127}_{53}I + beta^- \quad (9.4\ hr)$$

Transmutations are an important aspect of the convincing nuclear indicators in the field of cold fusion. Enduring integrity of cathodic material to be used in commercial devices must be considered in the engineering. We know the cathode changes. Now, if only the remaining skeptics would do the same.

Windows 2000?

The MODS theory can be a working hypothesis for researchers in 2000 by using the proposed mechanisms to help guide experiments. Here is a summary of the features of the cold fusion model that apply to the research:

1. More surface area allows more p or d chains. Granular or powdered metals are good for this.

2. Forget the bulk. Use thin-film or layered electrodes. Many researchers already seem to be taking this approach.[35]

3. Large crystal size allows for longer chains, but grain boundaries are needed for some of the active sites. However, as S.R. Chubb and T.A. Chubb note "it is also possible for coherent interaction to extend beyond the boundaries of individual crystals."[36]

4. Use lower to moderate current densities to reach the "π-notch plateau" (maximum heat), which occurs during the maximum rate of fusions in Window I.

5. Apply magnetic fields, especially with ferromagnetic electrodes such as nickel. The magnetic field lines should be parallel with intended direction of chain alignment. With metal powder or beads, two perpendicular magnetic fields can be arranged. This will encourage circular vortex motion of the chains around each tiny metal sphere.[37]

6. Apply microwave energy of selected frequency and intensity to the electrode. The frequency will resonate with the chains' frequency of oscillation. The longer and more concentrated or close-unit the chain, the lower the frequency.

7. Think entropy. A balance between lower entropy (favoring longer chains) and higher temperature (favoring greater invasion of chains) is desired. Cold fusion at low temperature (liquid nitrogen) using D-loaded proton-conducting perovskites in pressurized deuterium gas, with an oscillating electric field (microwave) and parallel magnetic field, while applying very low current to the perovskite, might permit you to "have your CAPE, and heat it too!" CAPE is Cold-Assisted Protonic Energy. Besides helping to make longer and straighter d chains, low temperature would increase the electron conductivity. Perhaps the deuterium-infused proton conductor can experience the best of both worlds: cold fusion using well-formed chains, *and* (maybe) electric current generation directly—at zero resistance—as a result of fusions in Window I.

Will a superconducting cold fusion battery result from item 7? If so, call it *Forever-Ready*. I have full confidence that the next big burst will not be one of neutrons, but of cold fusion devices coming forth to the marketplace!

Acknowledgments

I would like to thank the following people for their support and help in my cold fusion effort over the years, by publishing my articles, sending papers and reports, sharing correspondence and conversation, or offering timely encouragement: Eugene Mallove, Chuck Bennett, Hal Fox, George Miley, Millennium Twain, Peter Glück, Mitchell Swartz, Tom Passell, Russ George, Fred Jaeger, Bill Collis, Takaaki Matsumoto, Wayne Green, Jean-Paul Biberian, Robert Bass, James Griggs, Eiichi Yamaguchi, Takashi Nishioka and the late Steve Lazarus. I thank them and so many more experimenters and theorists in cold fusion for helping me participate.

I also want to thank Gordon Stine (Apple Valley, MN), Pastor Tom Parrish (Vision of Glory Lutheran Church, Plymouth, MN), William M. Johnson (Richfield, MN) and Thomas Malloy (Minneapolis, MN) for their enduring support and generous assistance. Thank you all.

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About the Author

David D. Moon, 55, of Minneapolis, Minnesota received a B.S. degree from Mankato State College (now Minnesota State University) in 1972. He formerly taught high school science in Wisconsin, Missouri, Texas, and Minnesota. He currently works as a security guard in a Bloomington, Minnesota office tower, which affords him some time to "ponder the mysteries of cold fusion" between building patrols. His nephews Jason, Jeffrey, and Joshua (ages 4-14) and nieces Jennifer (15) and Sarah (12) think cold fusion is "cool."

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Boscoli—From page 12

and not in physical contact with the target. This melting occurred at much higher voltage—about 5,000-8,000 V and at higher current, about 250 mA, according to Boscoli. At least he gave a numerical answer to *one* of my oral questions. This multi-kilowatt level could easily have melted the focuser and the glass near it, breaking the vacuum.

It appears that Boscoli came to believe that he had discovered an inverse relationship between heat and neutron production in this system. I do not believe that this relationship exists or can be supported by Boscoli's secret data at present, although I cannot prove that the relationship does not exist. We simply have no data. The apparent bottom line is that Cappelletti has unfortunately been led astray by a superficially sincere, but nonetheless not thoroughly grounded man—Boscoli. In turn, I was led astray in my expressed enthusiasm in Issue No. 27 by what I had *assumed* was Cappelletti's and Boscoli's skill in evaluating the calorimetry of this "intuitive," high-temperature process. It is an embarrassment for me and a sad lesson. I should never trust the measurement skill or judgement of others if I have not made a full independent assessment of their measurements myself.

I have counseled Cappelletti to resolve this neutron matter with 100% certainty by building a Faraday cage around a new BF_3 detector and electronics. (Boscoli agrees that his counter was subject to EM interference.) Then, if there is no radiation there and *if* Boscoli cannot or will not go back to examine the heat issue, then Paradigm Energy Corporation has nothing. It is a tragic farce. I feel some sympathy for Boscoli, since he is a skilled constructor and tinkerer and probably a good scientist in his past work. Unfortunately, he has made fundamental mistakes and he is his own worst enemy, whether he knows it or not. He lives in farm country in near squalor with a small $800/month pension from the Italian government. His rented concrete house is in the middle of a huge flat expanse of agricultural fields. Hunting of game is prevalent. I could hear the shots rings out in the October air. It was built in 1933. When the Boscoli's, who now have grandchildren, moved in eighteen years ago it did not have plumbing. He fixed it all up himself. Renzo's wife is a trusting, sweet old lady who is at his side always. She does the heavy house work. Boscoli has a well-stocked library with ancient texts and the modern Italian version of *Scientific American* (*Le Scienza*). Regrettably, he appears not to have been a very deep thinker about calorimetry, but we shall see—even though I hold out little hope for this.

On this visit I learned to my astonishment that a few years

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Technical Note/Correction

by Ken Rauen

Some of the statements made in my previous articles are wrong or poorly stated. I wish to point out these errors and correct them for the readership. These corrections do not change the basic hypotheses of my research into engine thermodynamics. They clarify my imperfect portrayal of our imperfect knowledge of the laws of physics, which I endeavor to expand and correct through research.

In the first article in *Infinite Energy*, No. 15/16 (pg. 109), "A Unity Engine," it was stated, "The Second Law does not say how much energy must be added. . .the energy input just merely needs to exist to satisfy the Second Law. . ." It is better to say that the Second Law requires an energy input which depends upon the isolated system's conditions, and may approach zero under certain circumstances.

•The article refers to the Boltzmann distribution on page 109; this should be the Maxwell-Boltzmann distribution.

•On page 111, "The engine processes which support subambient expansion must be GFE [Gibbs free energy]-driven. . ." Additional engine cycles which do not have GFE-driven processes have been found. I have found some other processes, still proprietary, and Sanjay Amin of Entropy Systems, Inc. has found processes also. See the Internet website, www.entropy systems.com.

•Also on page 111, under the sixth reason, it is stated, ". . . therefore an airfoil will see no net pressure to cause lift." It should state, "no net force."

•The first article also refers to two mathematical proofs. Four exist now. This is not an error, only an update.

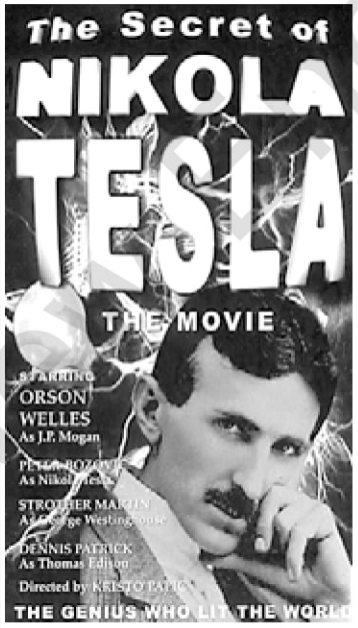
Another update is that I have discovered a discrepancy in classical thermodynamics. A Second Law analysis of the isovolumetric heating step in the Stirling cycle shows nonconformity to the Second Law; the net entropy change of that isolated control volume is negative! This is true regardless of which working fluid is used. Steam, nitrogen, and R-134a all show the same behavior. The changing temperature of the regenerator must be included. The author asks the readership to verify this condition. It is a specific, major challenge to classical thermodynamics because the Second Law is said to be absolute.

The follow-up article in Issue No. 17 (pg. 93), has corrections also. On the lighter side, super-"Carrot" engines is a typo, an artifact of scanning the manuscript, presumably.

•Page 94 states, "Spontaneous thermal energy transformations can only produce entropy increases, but spontaneous GFE transformations can also produce entropy decreases." This is not true as stated. What is true is that the processes which make a classical engine cycle spontaneous, such as heat input or expansion, always have increases in the entropy of the working fluid in those steps under realistic conditions. Those steps drive the other steps of the engine cycle which are nonspontaneous. It is true that GFE processes can be spontaneous with the working fluid undergoing a decrease in entropy. A more complete truth is that an isolated system of a spontaneous GFE transformation will still see a zero or a positive change in the system entropy, even though the fluid entropy change was negative. The thermal energy transformation of condensation of a vapor has a negative entropy change for the fluid, though the isolated system of this step has a realistic positive entropy change due to the heat gain of the heat sink. This process is not normally thought of as being spontaneous, as the heat must be actively removed for it to occur. In contradistinction, a spontaneous chemical reaction will proceed without any intervention, being truly spontaneous, and can result in a negative entropy for the products. The system entropy is slightly positive because of the heat released to the environment, which is part of the isolated system.

•The point of the second to last paragraph in the Issue No. 17 article is that real world processes, which can be isolated systems for the sake of analysis, can have nearly zero entropy increases. The evaporator in a vapor compression refrigerator is just such a case. One hundred percent of the heat absorbed by the evaporator is converted to internal energy in the refrigerant under realistic conditions. This isolated system has a realistic entropy change of just above zero. The theoretical, reversible system has an entropy change of zero. The only inefficiency in the realistic energy transformation is a small drop in temperature across the evaporator wall; there are no other losses, and the reversible evaporator system has no losses at all. The losses in a heat pump or refrigerator are primarily due to other steps of the cycle, the ones which are above ambient temperature. These superambient processes are primarily what cause a realistic COP to decrease from the theoretical, reversible COP.

❑❑❑



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Critics Kill Prof. George Miley's Historic U.S. DOE Low-Energy Nuclear Reactions Contract

In Issue No. 26 of *Infinite Energy*, we reported that Prof. George Miley's Low-Energy Nuclear Reactions (LENR) Group at the University of Illinois had been awarded a peer-reviewed U.S. Department of Energy contract—for an experimental study to verify previously tested electrolytic techniques to remediate radioactive nuclides. In Issue No. 27, we reported that Miley's grant was in danger of being eliminated by a chorus of cold fusion critics who protested to DOE officials about the award. The critics have now succeeded in getting the Miley grant killed.

Miley's funding of approximately $100,000 has been eliminated by DOE before one penny of it was transferred to the University of Illinois. A secret "review" of the science behind the award by an *unnamed* panel of six individuals (increased for some unknown reason from the original three panelists) did the killing. Other universities winning these NERI—Nuclear Energy Research Initiative—awards have received their funding already.

Infinite Energy's Eugene Mallove maintains regular contact with U.S. Senator Bob Smith's office, keeping Senator Smith and his advisors apprised of the current state of the cold fusion field. In this instance Senator Smith obliged with a thoughtful letter to the DOE, advising them not to be "closed to new ideas and approaches." We reprinted his July letter in our last issue. The DOE official, William D. Magwood, IV, who caved in and lowered the boom on Miley's grant, responded to Senator Smith with the following vacuous letter:

Dear Senator Smith:

Thank you for your letter of July 28, 1999, to Mr. John C. Angell, expressing the concern of Dr. Eugene Mallove, Editor-in-Chief, *Infinite Energy* Magazine, over an article in the July issue of *Science* magazine stating that the Department of Energy is taking extraordinary measures to review a grant made to professor George Miley of the University of Illinois. You encouraged the Department to reconsider placing "additional impediments" in the way of this research project. Your letter was forwarded to the Office of Nuclear Science and Technology for reply.

The proposal in question, selected for negotiation of an award under the Nuclear Energy Research Initiative (NERI) is entitled Scientific Feasibility Study of Low Energy Reactions for Nuclear Waste Amelioration. This proposal was first reviewed by a peer review panel in the field of nuclear waste technology as identified in the proposal. We believe this review was appropriate. However, the unique and crosscutting nature of this proposal prompted us to conduct a further evaluation of the proposal by six independent peer reviewers specializing in the fundamental sciences, appointed by the Department's Office [sic] Science. This review, completed on September 7, 1999, did not recommend that this proposal be funded. As a result, there will not be a NERI award for this proposal in fiscal year 1999.

We hope this answers the questions raised in your letter. Please contact us any time if you have any further questions.

Sincerely,
William D. Magwood, IV, Director
Office of Nuclear Energy, Science and Technology

As this issue of *Infinite Energy* goes to press, we are in direct contact with Ms. Hope Williams of the DOE's publicity office, in an attempt to have at least two major questions answered about this travesty: (1) Did the impetus to have Miley's grant reviewed come from outside the DOE or from within? and (2) What are the names and affiliations of the six panelists who killed the contract? DOE policy prohibits DOE managers from talking to the press without clearance by the DOE press office.

As reported in my last month's "Breaking Through" editorial, we have solid information from a DOE insider that one of the six panelists was Dr. John Huizenga of the infamous 1989 DOE ERAB Cold Fusion Panel. Huizenga could hardly be considered an unbiased reviewer. We wonder who were the other review panel participants. David Malakoff's article in *Science*, (September 24, 1999, "Thumbs Down," p. 2043) reports that "six new reviewers recommended that DOE spend its money elsewhere." According to an e-mail from Malakoff to Miley, this was a unanimous decision. NERI's John Herczeg notes to *Science*, "We'll be taking a closer look from now on."

Thus does a Federal bureaucracy work—quaking in its bureaucratic pants at the slightest whiff of "political embarrassment" threatened by the high-priests of official science. One would have hoped that "the unique and crosscutting nature of this proposal" referred to by Magwood in his letter would have made this a prized piece of research work that might have led to a window on revolutionary science and technology. Not so. The Federal government wants uniformity and incrementalism in its wasteful DOE funding.

NIF Hot Fusion Comes Under Fire
Hot Fusion Funding Gets Boost

U.S. Secretary of Energy Bill Richardson was "deeply disturbed" late last summer when he found out that officials at the Lawrence Livermore National Laboratory, which manages the $1.2 billion laser fusion National Ignition Facility (NIF), had not informed him of cost overruns and project delays. In June, NIF officials had assured him that all was well with the project. Though some $800 million has already been spent on the stadium-sized, 192-laser monstrosity, its 2003 scheduled completion date has been delayed and it appears to have a cost overrun variously projected to approach $300 million beyond the $1.2 billion mark. Some eleven "management reviews" over the past five years have stated that the project was on schedule and on budget.

In late August another black mark was dealt the project when NIF's director Michael Campbell resigned after it was learned that, contrary to what he had led others to believe, he had not received a Ph.D. from Princeton—his dissertation had not been completed.

Despite its high cost, the alleged purpose of NIF has nothing to do with providing the American people or the world with a new source of energy—although

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that is always obliquely used as a budgetary selling point. Rather, NIF is intended to maintain the "safety and reliability of the U.S. nuclear stockpile."

In other fusion news, in late September President Clinton signed into law a 4.3% increase in the DOE Office of Science's budget, now at $2.8 billion. This is the very Office that killed the Miley low-energy nuclear reactions contract. David Malakoff in *Science* (October 8, 1999) reported the gift to the hot fusioneers that is part of this budget increase: "Fusion energy was the biggest winner: Congress approved $250 million— $27 million more than DOE requested and $20 million more than it spent in 1999." Oh, the joys of having "infinite" OPM—"other people's money"!

Wall Street Journal Features

Cold Fusion in "On the Fringe" Section

On September 13, the *Wall Street Journal* published within its regular edition a special 20-page section: *Energy: Power to the People*—"How technology and deregulation are creating a new world for energy consumers and producers."

Editor Lawrence Rout introduced the section with this comment: "I'll be the first to concede: Energy isn't the sexiest sounding subject in the world. And last year, when we first thought about doing an energy report, there was some skepticism about whether there would be much interest among readers. But the more we talked about it, the more we became convinced that this was a hot topic. It was one that many of us felt we *ought* to understand, *ought* to follow closely, but we just didn't *get*." [Rout's italics]

On page 16 of this section we find the sub-section devoted to you-know-what—"fringe" ideas in energy, such as cold fusion. Since veteran science journalist Jerry Bishop retired from the *Wall Street Journal* some years ago, it has been nearly impossible to learn anything about cold fusion by reading this otherwise excellent newspaper—the WSJ even missed reporting the tenth anniversary date last March 23. That is unfortunate. Perhaps this initial revived attempt at cold fusion reporting will signal a change at the prestigious paper.

Written by reporter Erik Baard of Dow Jones Newswires in New York and Frank Byrt of Dow Jones Newswires in Boston, about a third of the "On the Fringe" page is white space or illustrative cartoons. The sub-banner reads, "Scientists and entrepreneurs have lots of ideas about new sources of energy. Some may even be practical."

The article leads with a brief discussion of NASA's interest in rocket engines that employ stored anti-matter. Following this we learn of the continued interest at NASA in the Podkletnov *et al.* experiments in gravity force reduction (see *Infinite Energy*, Issue No. 9, pp. 49-50), which could also be a source of energy—if said gravity reduction were differentially applied to a rotating device, for example.

A section of this page bannered "Bigger than Fire" treats the work of Dr. Randell Mills of BlackLight Power Inc. of Cranbury, New Jersey (see *IE* No. 17 for an extensive interview with Mills). The article states that Mills thinks his theory of "classical quantum mechanics" that allows sub-ground state hydrogen atoms is "bigger than fire." The piece also suggest that Mills believes that the energy-from-water aspects are just a "spinoff."

This magazine has previously revealed that electric utility Pacific Corp of Portland, Oregon has invested in BlackLight Power. The *WSJ* piece reveals now that Conectiv of Wilmington, Delaware has also invested in BlackLight. Mills claims a present capitalization for his company of $20 million, according to this article. Though a Mills supporter is quoted, we also have Nobel laureate Steven Chu of Stanford University rendering the opinion: "It's extremely unlikely that this is real, and I feel sorry for the people who are backing this." To that we reply, with an out-of-context take-off on one of Dr. Robert Park's lines, "As far as new energy is concerned, a Ph.D. and a Nobel Prize is no inoculation against foot-in-mouth disease or a guarantee against uttering foolishness."

Next in the *WSJ* smorgasbord of fringe energy come the solar power satellites, the idea of beaming down to Earth microwave energy generated in large-area satellites from solar light flux. Right after that we get the cosmic extension cord idea—"Extension Cord Redefined." This is the plan to link solar power satellites with a "superconducting beanstalk" tether to bring electric energy down to earth. The strong but lightweight material of the "beanstalk" would be carbon fiber nanotubes, so its supporters say.

Finally we get to the hot and cold fusion section, dubbed "Hot and Cold." We have the obligatory and true statement, "Though billions of dollars have been spent world-wide on complex equipment and nearly fifty years of research efforts, fusion has yet to develop as a practical source of power." The article notes that the hot fusioneers are looking longingly at the Moon's supply of "the kind of helium ideal for fueling fusion" (helium-3).

To balance this, we find this summary of cold fusion: "Cold fusion, regarded as discredited by most physicists, has attracted few research dollars." True enough! "Still, a small group of impassioned scientists remain convinced that it will become a cheap, limitless source of energy." Oh, why are we always so "impassioned"? Of course, the hot fusioneers are never "impassioned"—they just collect their billions of dollars endlessly. No passion needed for that, just guile. We are grateful that the *WSJ* mentioned *Infinite Energy* and provided its readers with a quote from yours truly and also one from Prof. George Miley. The APS's Robert Park gets in his anti-CF licks— he says he's still waiting for his warmed "cup of tea." To the reporters' credit they remark, "But ideas that once seemed as outlandish as cold fusion, gravity modification, or beanstalk tethers have outlived their detractors before." Amen to that, brothers!

Cold Fusion Session and Randell Mills' Work

Featured at Prestigious Meeting, Despite Critics

The 1999 Pacific Conference on Chemistry and Spectroscopy and the 35th ACS (American Chemical Society) Western Regional Meeting was held October 6-8, 1999 at the Ontario Convention Center in Ontario, California. Despite threats by opponents to get rid of it (as reported in my editorial last issue), on October 8 there was a full day session devoted to electrochemistry, with more than a half-day's worth of low-energy nuclear reactions talks. The program for the session was organized by cold fusion researcher Dr. Melvin Miles of the Navy's NASWC, China Lake, California. Featured speakers were Martin Fleischmann, Edmund Storms, Michael McKubre, Stan Szpak, John Dash, Robert T. Bush, and Melvin Miles.

Separate from the cold fusion session, Dr. Randell Mills and several colleagues spoke at the ACS meeting on October 6. BlackLight Power, Inc. (BLP) issued a press release (see its website for the full text www.blacklightpower.com): "RESEARCHER

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UNVEILS UNIQUE NEW CLASS OF HYDRIDE COMPOUNDS—Discoveries Point to New Source of Low Cost Energy, Longer-Life Batteries, Magnetic Polymers, Lighter-Weight Materials; All Based on BlackLight Power's Application of Dr. Randell Mills' 'Grand Unified Atomic Theory'"

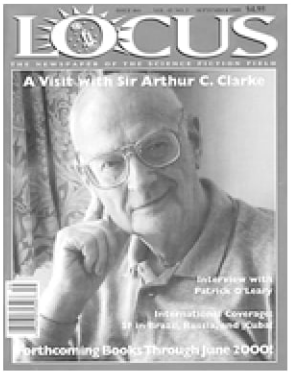
The press release noted the appearance at the meeting of Dr. Johannes Conrads, retired Chairman of the Board and past Director of INP, Greifswald, Germany, one of the world's foremost research centers for the study of low temperature plasma physics. Dr. Conrads discussed "INP's independent study of Mills' theory, which has demonstrated the generation of extreme ultraviolet emissions at low temperatures from atomic hydrogen."

According to the press release: "The world could have a new source of low-cost, renewable, pollution-free energy because these reactions can be harnessed to create electricity. When hydrogen transitions to these lower stable states, energy in the form of extreme ultraviolet light is released. Extraordinary compounds are formed as by-product. An early application of these products would be vastly improved high voltage batteries with at least 10,000 times the power of conventional batteries, charged and recharged with low-cost electricity. This could help usher in the age of the electric automobile."

Mills and his colleagues from BLP presented four papers discussing the synthesis and characterization of the claimed new class of hydride compounds. The BLP press release states that two of the papers have been accepted for peer-reviewed publication, one in the *International Journal of Hydrogen Energy*, published by the International Hydrogen Energy Association, and the other in *Fusion Technology*, published by the American Nuclear Society.

The press release presents this financial news: "BlackLight Power's most recent private offering was quickly oversubscribed, and the company has signed an agreement with Morgan Stanley to serve as its investment bank. Along with the financial backing of several major utilities and manufacturing companies, BlackLight is capitalized at more than $20 million." More: "BlackLight Power is expanding rapidly, with a major 53,000 square-foot research and development facility slated to house more than 100 researchers and supporting staff located in Cranbury, N.J., near Princeton, N.J. Mills has been awarded patents by Australia and South Africa within the past year, and has several patents pending in the United States."

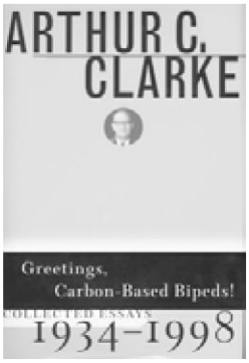
Sir Arthur C. Clarke
Makes More Waves



Locus, a glossy monthly magazine that is "The Newspaper of the Science Fiction Field," featured in its September 1999 issue an interview with Sir Arthur C. Clarke. His pleasant photo graces the issue's cover. Interviewer John L. Coker, III asks Clarke at one point, "What is the greatest danger in the world today to humankind?" Clarke replies, in part: "Humankind. Our only hope is intelligence and common sense, which is so uncommon. . ."

Clarke ends his interview with this plea: "If I could be granted three wishes, they would be: 1) Peace in Sri Lanka—and the whole world, if that's not asking too much; 2) The first commercial prototypes of the clean, virtually infinite energy devices which will end the fossil fuel age; 3) Proof of life elsewhere—preferably intelligent, though I'd settle for anything that can put a couple of cells together. There are indications that the first may be in sight— and I've been expecting number 2 'real soon now' for the past five years. As for the third—well, your guess is as good as mine."

More waves. In Clarke's latest book, *Greetings, Carbon-Based Bipeds! Collected Essays 1934-1998* (St. Martin's Press, New York, 1999, ISBN 0-312-19893-0), we read this nice "plug" for *Infinite Energy* on page 528 in the "Science and Society" essay: "Well, for those (90 percent of?) scientists who have been too busy to look into the matter, or thought it was closed, there is now no further doubt that anomalous energy is being produced by several devices, some of which are on the market with a money-back guarantee, while others are covered by patents. The literature on the subject is now enormous: it's all over the Web, but the most convenient source is Gene Mallove's *Infinite Energy* magazine (P.O. Box 2816, Concord, NH 03302-2816." Thank you Sir Arthur — and may all your wishes come true!



Examiner Tom Valone is Fired from the Patent Office for Supporting Cold Fusion

Press Release from Integrity Research Institute

The Conference on Future Energy (COFE), April 29-May 1, 1999, hosted by Integrity Research Institute (IRI), was a milestone for emerging energy technology (see *IE*, Issue No. 26, p 10). Many of the speakers had not been presented to a new energy audience before and people came from all over the world (Germany, Australia, Japan, Russia, and elsewhere) to hear them. Furthermore, there was a lot of tension in the air, because the State, Energy, and Commerce Departments all attempted to kill the conference after arrangements had been made at each of the government facilities. Even worse, the American Physical Society's Public Affairs Director, Robert Park, encouraged the State Department's Peter Zimmerman to kill the conference at State (*IE*, Issue No. 25, p. 25) and then together they launched a coordinated effort to effect a termination of the organizer, Thomas Valone, from his Commerce post as a patent examiner—a post he had held for three years.

Framing him as a conspirator, "lusting" for government acceptance of pseudoscience (using Park's terminology), Valone's character was assassinated with a four-page proposal for removal that referred to some of Park's prejudiced commentary. Charged with misrepresentation and conflict of interest for the tenative COFE event, which never took place at Commerce, but instead was held at a hotel, Valone's fully successful performance and clean record of employment with the Patent Office was outweighed by the "seriousness" of the "crime." The case has now gone to arbitration and will take more than a year to be heard. In the meantime, Thomas Valone is now dedicating most of his time to the nonprofit service of future energy as President of IRI. Though not associated with the government's Office of Research Integrity, perhaps it should be, since the integrity of energy research is at the heart of the present controversy that cost Valone his government job.

New Energy Times Archive

Boscoli—From page 42

ago, without Cappelletti's knowledge, Boscoli secretly went to a patent firm to begin filing the warm fusion patent. Earlier he had resisted filing any patent because he feared this work would also be stolen "by the Americans." The patent was written without any reference to Cappelletti, who had helped him. When Cappelletti found out about this he was extremely upset and used formal legal pressure against Boscoli to get the patent application assigned to him; the legal threat was to have the patent "sequestered." Boscoli caved in and the patent is assigned to Cappelletti. The engineer in the patent firm who helped write the patent told Cappelletti that this secret action by Boscoli was the worst thing he had ever seen done. Still, Cappelletti's belief and support of Boscoli is so strong that he cannot do what he should do as a CEO—get control of the company's scientific affairs and disclosure of information. Above all, he should find out whether his company really has anything valid to purvey.

At the end of my stay, at the Bologna airport Cappelletti showed me some photos which Boscoli had apparently not wanted him to share with me—otherwise he certainly would have sent them to *Infinite Energy* earlier, before my trip to Italy (rather than the extremely faint glow discharge photo we were then given—see photo on page 10). We had intended to put such a bright color photo on the cover of this issue. These other photos were evidently from tests at higher voltage and higher power levels, because the glow of the tube was orders of magnitude brighter than what I had seen during my visit. There is no way without numbers to judge what these exciting pictures may mean.

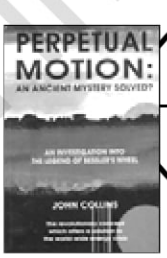
There is some good news in Italy, for which we can be thankful, to go along with this painful story about Boscoli. Prof. Sergio Focardi, whom I met in the course of my visit, is the co-investigator with Prof. Francesco Piantelli on the patented excess heat-producing process that uses thermally triggered excess heat in pure hydrogen gas atmospheres in contact with nickel (see *IE* No. 4, p. 24). He had come back to Bologna from the Asti conference. He said that work on their gas phase excess heat continues—first announced in Siena, Italy in 1994. It is said to be on very solid, repeatable ground. For two months on end, with what they believe is no sign of stopping, they get about 14 watts excess heat with, for example, 60 watts heater input power. The absolute magnitude of the heat stays the same for a given geometry, no matter what the input power. They might, for example, have 114 watts output with 100 watts in. The surface of the nickel is covered afterwards with the largely metallic transmutations Ca, Cu, Zn, Na, Mg, Cl, etc. (as measured by EDX). Of course, this claim needs to be checked too, but it is very similar, Focardi said, to the metallic transmutation spectrum being seen by Prof. George Miley at the University of Illinois. Unlike Boscoli, Focardi *et al.* share their data with other cold fusion scientists in Italy. They have not been independently verified or replicated, however.

Cappelletti had told me in recent months, with great assurance, that the Boscoli process was so obviously real that it was "intuitive." This statement, it turns out, is meaningless. I had assumed it meant that the heat was spectacular—such as a self-running process perhaps, or with such minute input power producing huge thermal effects. I assumed, incorrectly, that he understood perfectly well what kind of excess heat producing process and its attendant measurements would have to be provided to have this be incontrovertible.

Renzo Boscoli is a sad figure who trusts almost no one from outside and may well have some fear that "the Americans" will steal his process. When I was there, he apparently got upset that I briefly used a tape measure to ascertain the general sizes of the components of his apparatus. (I had roughly the same experience with the now deceased paranoid inventor Stanley Meyer, when I visited his laboratory in the early 1990s.) Boscoli believes some of his other technological ideas have been purloined. For all I know, maybe they have been, but that does not justify this present behavior.

Remember this: Boscoli's excess heat "discovery," if it is real at all, apparently remains hidden by him in those "coded" notebooks that Cappelletti as CEO of Paradigm Energy Corporation is not allowed to see. He does not even know where they are. Boscoli has been controlling every release of information about what he has been doing for the past decade. Cappelletti fully acknowledges this and doesn't like it, but he feels trapped. I told Cappelletti that he cannot go on like this. If this idea is really of value and proved so by others, a process like this could be the "miracle" breakthrough that we had hoped for. As this article went to press a few days after I returned from Italy, Cappelletti called me to say that a large "conglomerate" had contacted him to tell him that it had reproduced the Boscoli process. What they had found, he had not yet heard. For now, sans data of any kind, the Boscoli process is just another profoundly discouraging, possibly terminal case of inventor's disease.

PERPETUAL MOTION:
An Ancient Mystery Solved?



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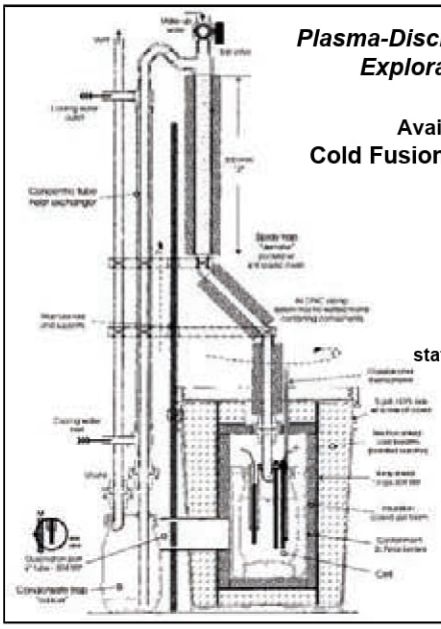

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8th International Conference on Cold Fusion
May 21-26, 2000

The 8th International Conference on Cold Fusion, ICCF-8, will take place in Lerici, Italy, May 21-26, 2000. The study of Cold Fusion phenomena, sometimes referred to as "New Hydrogen Energy," is progressing in numerous laboratories all around the world. More than ten years old, the field is enjoying ever more reproducible experiments and a better interaction with the scientific community. A large variety of experimental approaches will be addressed in the Conference together with theoretical attempts to interpret the observed phenomena.

List of Topics:

- Heat and related products
- Nuclear processes and transmutations
- Materials
- Innovative approaches
- Theories

The Conference will consist of oral and poster presentations. The official language of the Conference is English. Pre-registration, registration and submission of abstracts should preferably be performed using the Conference Webpage:

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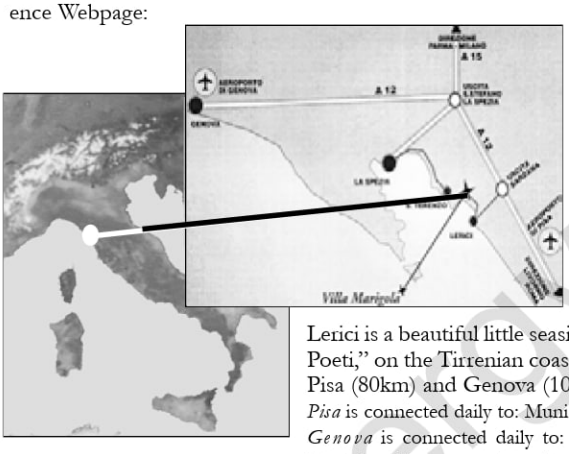

www.frascati.enea.it/iccf8

Lerici is a beautiful little seaside town in the "Golfo dei Poeti," on the Tirrenian coast. The closest airports are Pisa (80km) and Genova (100km).
Pisa is connected daily to: Munich, London and Paris
Genova is connected daily to: Frankfurt, Zurich, London, Munich. There are domestic flights connecting Pisa and Genova with Milano Malpensa and Roma Fiumicino. Once in Pisa or Genova, you can reach La Specia by train.
The trip takes about one hour. From La Spezia a bus will take you to Lerici in about fifteen minutes. A shuttle service to and from airports at the beginning and at the end of the Conference is being considered. More detailed information about travel and site are available on the Conference webpage.

Organized by: The Italian Agency for New Technologies, Energy and the Environment
With the sponsorship of : Consiglio Nazionale delle Ricerche (CNR), Istituto Nazionale di Fisica Nucleare (INFN), and the Società Italiana di Fisica (SIF)

VILLA MARIGOLA is situated on a hill just outside the village of Lerici. Shuttle service will be available for the five days of the meeting to/from Lericito from Villa Marigola. The mild Liguirian climatic conditions are extremely suitable to activities all year long. The hotel owners guarantee that this is a place where work can be mixed with moments of peaceful relaxation and where excellent food can be enjoyed.

VILLA MARIGOLA, Lerici (La Specia, Italy)

CALENDAR

The "Millennium Congress on Energy and the Environment"
January 24-28, 2000
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This letter has been around the world at least seven times. It has been to many major conferences. Now it has come to you. It will bring you good fortune. This is true even if you don't believe it. But you must follow these instructions:

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Do not break the reference loop, but send this letter on today. Dr. H. received this letter and within a year after passing it on she was elected to the National Academy of Sciences. Dr. M., however, threw this letter away and was denied tenure. In Utah, Dr. I. received this letter and put it aside. His article for *Family Medicine* was rejected. He found the letter and passed it on, and his article was published that year in the *New England Journal of Medicine*. In the Midwest, Prof. K. failed to pass on the letter, and in a budget cutback his entire department was eliminated. This could happen to you if you break the chain of citations.

1. Miller, J. 1992."Post-modern Neo-cubism and the Wave Theory of Light," *Journal of Cognitive Artifacts*, 8, 113-117.
2. Johnson, S. 1991. "Micturition in the Canid Family: The Irresistable Pull of the Hydrant," *Physics Quarterly*, 33, 203-220.
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4. David, E. 1994. "Modern Approaches to Chaotic Heuristic Optimization: Means of Analyzing Non-Linear Intelligent Networks with Emergent Symbolic Structure," Doctoral Dissertation, University of California at Santa Royale El Camino del Rey Mar Vista By-the-Sea.

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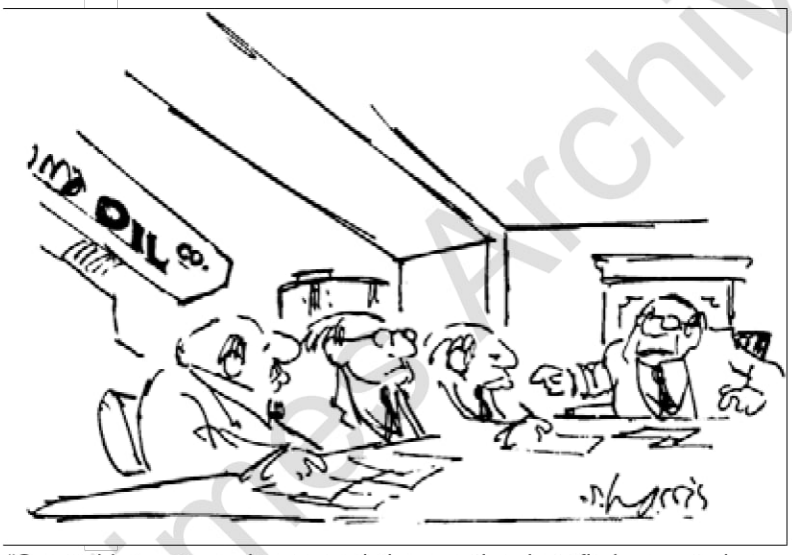

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"The Dead Scientists Poetry Society"

By Susan Seddon

PASCAL BLAISES A TRAIL

I took time out to write this verse
I'm always under pressure
Inventing this, defining that
So little time for leisure.

I built a computer for my dad
Which the lass next door just "lurves"
She's dumb on projective geometry
But inspires me on cycloid curves.

No prob. beats mathematicians
Not even that time when
My hydraulic press got jammed with mud
I just worked it out with a pen.

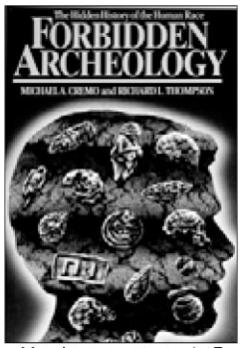
I'm busy now with cones and planes
It's going quite well, of course
One thing I know for certain
I won't put descartes before horse.

NEXT ISSUE:
"Daddy's Girl" by Ada Lovelace

New Energy Times Archive

Introduction

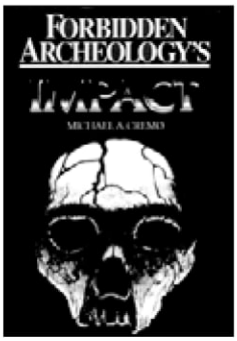
This review is not so much about the subject matter of three closely related books, but rather about the nature of evidence and its treatment when a favored paradigm is challenged. I could take the drama outlined in the books, change a few names and places, and it would do very well for the last decade of cold fusion and related developments.



Hardcover, 1993, $45
ISBN 1882693000
Torchlight Publishing

The Books

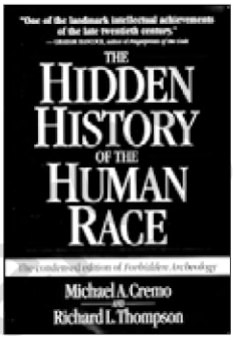
There are three, *Forbidden Archeology*, *Forbidden Archeology's Impact*, and *The Hidden History of the Human Race*. The last (*HHHR*) is an abridgement of the first (*FA*), which runs 914 pages, authored by Michael A. Cremo and Richard L. Thompson. Cremo alone authored the middle (*FAI*).



Hardcover, 1998, $35
ISBN 0892132833
Torchlight Publishing

Forbidden Archeology is about evidence that anatomically modern humans existed on earth millions of years ago, well before the prevailing view that humans evolved about 100,000 years ago. It is also about epistemology, the nature of knowledge. The evidence necessarily involves the interpretation of the origin and age of artifacts found in different locations by different people.

The most commonly discussed artifacts are stones and bones. The stones are flint, flaked by pressure or impact to form cutting points and edges. The bones carry marks made by the tools in butchering game. Age of the stones and bones was established at first by geological context and later by radiological methods. Once an artifact is removed, the context is reduced to the finder's account, vulnerable to challenge by critics who were not there.



Paperback, 1996, $16
ISBN 0892133252
Torchlight Publishing

Stones

One example will serve. A reproduction of a careful drawing of a flint tool is shown in Figure 4.34, reprinted with permission from BBT Science Books.

The Oligocene period ended thirty-eight million years ago. The implement was found below these sands, indicating a still earlier formation and deposit. Rutot was conservator of the Royal Museum of Natural History in Brussels. Workmanship details are equivalent to implements found in Neolithic, or Stone Age, contexts and accepted as human manufacture. A critic who was not there can imagine that tumbling, or the movement of other stones, might have fortuitously exerted the pressure needed to flake the flint into the shape shown. Arguments raged and there were attempts to develop objective criteria for deciding if a particular artifact was of intelligent manufacture. Of course, these "objective criteria" became topics of controversy.

Beyond flint tools, mining operations have unearthed clearly manufactured objects such as mortars and pestles embedded in strata of great antiquity. But, of course, a miner, not a committee of academics, makes the discovery, and it is therefore questionable—unless it conforms to the prevailing paradigm, whereby it becomes just an incidental confirmation.

Bones

Quoting the Authors

Intentionally cut and broken bones of animals comprise a substantial part of the evidence for human antiquity. They came under serious study in the middle of the nineteenth century and have remained the object of extensive research and analysis up to the present.

In the decades following the publication of Darwin' s *The Origin of Species*, many scientists found incised and broken bones indicating a human presence in the Pliocene, Miocene, and earlier periods. Opponents suggested that the marks and breaks observed on the fossil bones were caused by the action of carnivores, sharks, or geological pressure. But supporters of the discoveries offered impressive counterarguments. For example, stone tools were sometimes found along with incised bones, and experiments with these implements produced marks on fresh bone exactly resembling those found on the fossils. Scientists also employed microscopes in order to distinguish the cuts on fossil bones from those that might be made by animal or shark teeth. In many instances, the marks were located in places on the bone appropriate for specific butchering operations.

Nonetheless, reports of incised and broken bones indicating a human presence in the Pliocene and earlier are absent from the currently accepted stock of evidence. This exclusion may not, however, be warranted. From the incomplete evidence now under active consideration, scientists have concluded that humans of the modern type appeared fairly recently. But in light of the evidence covered in this chapter, the soundness of that conclusion is somewhat deceptive.

This brings us to the epistemological issue, the treatment of evidence. Quoting the authors again,

In the first chapter of Part I of *Forbidden Archeology*, we survey the history and current state of scientific ideas about human evolution. We also discuss some of the epistemological principles we employ in our study of this field. Principally, we are concerned with a double standard in the treatment of evidence.

We identify two main bodies of evidence. The first is a body of controversial evidence (A), which shows the existence of anatomically modern humans in the uncomfortably distant past. The second is a body of evidence (B), which can be interpreted as supporting the currently dominant views that anatomically modern humans evolved fairly recently, about 100,000 years ago in Africa, and perhaps elsewhere.

We also identify standards employed in the evaluation of paleoanthropological evidence. After detailed study, we found that if these standards are applied equally to A and B, then we must accept both A and B or reject both A and B. If we accept both A and B, then we have evidence placing anatomically modern humans millions of years ago, coexisting with more apelike hominids. If we reject both A and B, then we deprive ourselves of the evidential foundation for making any pronouncements whatsoever about human origins and antiquity.

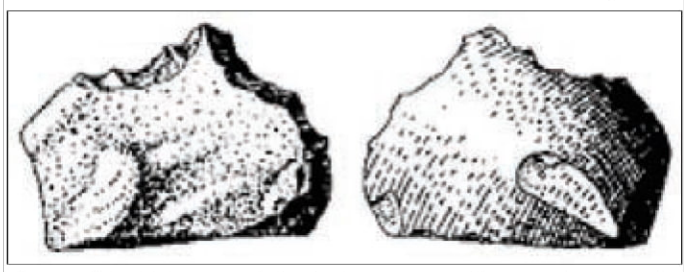


Figure 4.34. This pointed flint implement was discovered in a stratigraphic position below the Late Oligocene sands at Boncelles, Belgium (Rutot 1907, p. 461). The ventral surface (right) of this tool shows a well-developed bulb of percussion with an eraillure. According to Rutot, this type of implement is common in Neolithic and modern assemblages.

New Time Archive

Historically, a significant number of professional scientists once accepted the evidence in category A. But a more influential group of scientists, who applied standards of evidence more strictly to A than to B, later caused A to be rejected and B to be preserved. This differential application of standards for the acceptance and rejection of evidence constitutes a knowledge filter that obscures the real picture of human origins and antiquity.

The authors began testing a theory that humans and other hominids had co-existed for a very long time (see commentary section below). This led them through a trail of papers and books, footnotes and footnotes of footnotes, back into papers published in the 1800s before Darwin's *Origin of Species* in 1859. Darwin's book quickly shaped subsequent scientific work into a search for a "missing link," forcing into obscurity any dissenting evidence. No conspiracy was necessary, just neglect by footnote, repeated citations of supposed debunkers, etc. Careers of serious challengers were ruined, defenders fired, grants withheld. The authors describe this as a "knowledge filter."

Since removal of a specimen from its place of discovery ruined the context, each discovery is a non-repeatable experiment. It is easy to regard contemporary evidence as superior to older evidence. A contemporary "dig" is rigorously documented, photographed at every step. The authors searched for original reports and quote them in detail so that readers may judge the quality and integrity of observations made before photography was available.

FA was published in 1993. A firestorm of controversy was ignited, bringing both praise and summary condemnation from authorities in the field. *FAI* was published in 1998. Containing 568 pages, criticisms and answers are laid out in full detail, except where some individuals requested that their correspondence not be published. *FAI* includes reviews, letters, and even transcripts of Internet newsgroup discussions.

Details would expand this review beyond reason for *IE*'s readers, since the subject matter is outside *IE*'s field of interest. The books are detailed, specific, and balanced in presentation of evidence and criticism. Truly startling findings are segregated into a specific section of *FA*.

What is of interest to *IE*'s readers is the pattern of double standard evaluation of data in a controversial field. Experimental results and theories supporting the existing paradigms of physics are accepted, whereas evidence supporting cold fusion is subject to ruthless and imaginative scrutiny. Critics imagine extreme scenarios to debunk experiments supporting cold fusion results without subjecting the existing paradigms to the same tests. There is an admitted problem in exact replication of experiments, and a lack of theory. Similarly, an archeological "find" is a non-reproducible "experiment." In one instance a critic protested about a "controversial"artifact that only the artifact and the report of the circumstances was available—overlooking that for "acceptable" evidence, only the artifact and a report are customarily available.

Commentary

The authors are quite open about the motivation for their investigation. They are "members of the Bhaktivedanta Institute, an [*sic*] branch of the International Society for Krishna Consciousness that studies the relationship between modern science and the worldview expressed in the Vedic literature." This worldview accepts human presence into remote antiquity in a universe of cyclic creation and destruction. This motivation for research has led some critics to dismiss *FA* as "Vedic Creationism" to be left in the same basket with "Biblical Creationism." Such glib dismissal diverts readers from the painstaking detail of the author's research and presentation, which is altogether balanced. Cremo is a writer and editor. Thompson has a Ph.D. in Mathematics from Cornell University and has written on evolutionary biology.

FA gives no comfort to Darwinesque "missing link" attempts to find a common ancestor of humans and the other primates, despite the close similarity of human and chimpanzee DNA. Nor does it give comfort to fundamentalist Christian creation science—to the extent that advocates seek a compressed time scale for the creation process. It leaves the reader with a profound sense of mystery, that none of the accepted paradigms of the 20th century fit the whole span of relevant findings.

Science succeeds by limiting the universe of discourse to what can be tested by hypothesis and experiment. When it comes to the large issues, like the nature of the Universe and humanity's place in it, or control of energy resources which shape world politics, much is involved in selecting the battleground—such as who gets to define the nature of Man and sign the checks. Institutions of prestige and power seek justifications from intellectual positions, distorting the search for truth.

In the early 1800s, a Geological Society attracted a wealthy and influential following in England. The fascination was not with geology, but overturning the power structure of Britain. Authority flowed from God, through the Church of England, who anointed the Monarch, who ruled the people and Parliament sat at the Monarch's pleasure. Geological evidence for antiquity of the Earth invalidated the Bible story, undermining the line of authority. Now power flows from the people to an elected Parliament, and the Monarchy wields only ceremonial and advisory power.

Many indicators of an approaching paradigm shift can be found, suggesting that the sciences of the 20th century went astray in a fundamental way. Perhaps by backtracking and taking "the road less traveled by" (Robert Frost's poem), new energy sources and technologies, democratic in nature, will profoundly influence the distribution of political power in the world.

Device and Testing—From page 29

A distinct feature that Pantone employs is a special rod within the air/fuel stream.

Many amazing claims are made about this technology, which revolve around the idea that an air/fuel plasma forms in the heat exchanger. There is one clear anomaly that seems to stand out. There is a magnetic field near this exhaust/fuel heat exchanger, which was reported to be very strong (*i.e.* strong enough to erase credit cards from typical viewing distance of several feet). This strong field was not witnessed in the limited testing of the small type of device in our possession, but a field was found, initially using a compass, and it seemed to have some anomalous properties. The field associated with any piece of steel is typically stronger than the background geomagnetic field and non-uniform, as found by examining various samples around the lab with a magnetometer, so it should not be surprising that a field would be associated with the heat exchanger rod.

Testing over a year ago on this 10 HP Tecumseh GEET modified engine revealed that the rod and surrounding steel diverted a compass needle from geomagnetic north both while the engine was running and when it was not running. The magnetization of the rod was found to be N on one end and S on the other, with field intensity close to geomagnetic strength. The rod was installed in the engine with its N end toward the muffler. The engine was run for about 7 minutes and the rod was removed. The end that was N was now S. The rod was reinstalled in the same way, so now the end near the muffler was S. The engine was run for another 12 minutes. The rod was removed and its field checked again. This time, both ends were found to be N, and the center was S. These checks were made with both a compass and magnetometer. The thermal gradient along the length of the rod, combined with engine vibration, may cause seemingly random changes in magnetization. It is too soon to conclude anything, but this is interesting.

NOTES:

1. P. Raj, P. Suryanarayana, A. Sathyamoorthy and T. Datta. 1989. "Search for Nuclear Fusion in Gas Phase Deuteriding of Titanium Metal," BARC Studies in Cold Fusion, April-September.

2. F.G. Will, K. Cedzynska, M-C. Yang, J.R. Peterson, H.E. Bergeson, S.C. Barrowes, W.J. West, and D.C. Linton (National Cold Fusion Inst., University of Utah, USA). 1991. "Studies of Electrolytic and Gas Phase Loading of Palladium and Deuterium," presented at Second Annual Conference on Cold Fusion, June 29-July 4, Como, Italy. T. N. Claytor, D. D. Jackson, and D. G. Tuggle, "Tritium Production from a Low Voltage Deuterium Discharge on Palladium and Other Metals," Los Alamos National Laboratory, http://wwwnde.esa.lanl.gov/cf/tritweb.htm

3. E. Mallove. 1998. "Preliminary Confirmation Test of Dr. Les Case's Catalytic Fusion Process," *Infinite Energy*, **4**, 19, 33.

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5. GEET website: http://www.Friend.ly.Net/GEET/

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New Energy Times Archive

Book Review — Hal Fox

The Whispering Pond
by Ervin Laszlo
New Element Books, ISBN 1-86204-362-0
$18.95 paperback

If you read this book your concept of the role and progress of science may be demolished or at least expanded. The author (with over fifty books preceding from pen and word processor) takes us on a journey of amalgamation. The author presents his thesis in four parts: 1) The Established Vision, 2) A Blurring Image, 3) In Quest of a New Understanding, and 4) The Emerging Vision.

In each part Laszlo takes the reader on an excursion through the cosmos, matter, life, and mind (in separate chapters). The reader should be amazed at the depths of understanding shown by the author as he reports, explores, and reformulates these diverse, and yet interwoven, fields of scientific explorations. Not only does Laszlo convince the reader that the author understands these diverse concepts but also Laszlo presents these complex ideas so that the reader can understand them. A daunting task, nobly performed.

Beginning with the basic current explanations, theories, and hypotheses of cosmos, matter, life, and mind Laszlo then tackles the problems that scientists are struggling to improve, replace, or abandon. Next in this foray into problems, the author lays the groundwork for the need of a *really grand universal theory* that in one great swoop of intellect can amalgamate all of our cosmos, matter, life, and mind into one great basic concept of interrelated understanding. A noble challenge.

The author meets the challenge with a combination of concepts coming from both western and Russian scientists. The grand basic concept is a *quantum aether* coupled with *torsion fields* and the exchange of information at a billion times the speed of light. The author cites the work of Akimov (among others) with the comment that these writings have not (at the time of the author's writing—1996) been published in the West. [We are pleased to tell Laszlo that Akimov's review of torsion fields has been published in the *Journal of New Energy*.] Prior to getting to the part of his book where torsion fields are first mentioned, this reviewer was marking up the margins with notes indicating that the torsion fields should be used by the author.

This reviewer has only one nit-picking criticism. If the author is so well-schooled on some of the advanced concepts of science (especially torsion fields), why are his explanations laced with Big Bang concepts? We recommend he read the following article: P. Anastasovski *et al.*, 1996. "A New Approach to the Cosmic Red-Shift and to the Cosmic Microwave Sources," *J. New Energy*, **1**, 2, Summer, 79-87.

The following is a quote from the author's book concerning a fifth unifying concept: "The interconnection holofield is not likely to be a gravitational, electromagnetic, or nuclear field: it is more likely to be a *fifth field* in the universe. . . The discovery of this field and its inclusion in the repertory of physically real events will make for a fundamental shift in the world picture projected by science. We shall trace the contours of this shift in the next and last chapter, as we contemplate the cosmic dance of matter, life, and mind in *the whispering pond:* in our subtly interconnected universe."

Finally, in the last chapter, the author begins with this: "What shall we call the field that makes us, and all things in nature, organic parts in a subtly interlinked cosmos—in a cosmic *whispering pond?* If that field is a major, indeed a paramount, element in the universe, it deserves a name of its own. Describing it as the *vacuum-based zero-point holofield* is accurate but cumbersome; and the names with which other fields have been christened previously do not correspond to the insights now surfacing about the nature of this cosmic field." This reviewer will leave the discovery of the suggested name to be provided to the reader by the author.

If a walk through various fields of science, its successes, its problems, and its possible unification is an appealing journey, this is an excellent guide. It is recommended that those interested in any of the facets of cosmos, matter, life, and mind buy, read, and reread this book.

COLD FUSION TIMES
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The most progressive energy inventors and scientists were assembled for COFE and all three government agencies that offered space for the event reacted with fear when the description of the speakers' topics became apparent. Most troublesome was that COFE dared to include a few cold fusion presentations along with the rest of the breakthrough energy technologies. To summarize COFE, (*IE*, Issue No. 26, p. 10) the conference included Ken Shoulders, who detailed his amazing charge cluster technology. Dr. Paul Brown announced his remediation of nuclear waste technology and his betavoltaic battery invention. Les Adam discussed a unique peroxide powered, non-combustive helicopter and an electric car design contest sponsored by his Arkansas company, AZ Industries. The DOE allowed two of its engineers, Hamilton and Goodwin, to present the latest summary reports. Dr. Van Flandern amazed the audience with a scholarly presentation on the physics and speed of gravity, with a possible energy conversion modality. Dr. Ed Storms talked about transmutation in many of its forms, providing copious references. David Wallman had a demonstration of his carbon-arc gasification of biomass solutions. Dr. Graneau showed how his cold fog discovery is over-unity from its release of chemical bond energy. Bruce Perreault talked about several topics including his "Perreault valve." Paul Pantone started up a few GEET motors right in the hotel exhibit room. Tom Valone explained the latest zero point energy findings. Kent Robertson, from the American Wind Energy Association, gave an overview of the wind industry and explained why it grew by 25% last year. Bob Rose explained fuel cells and their expected debut on the automotive market. Saturday workshops included individual presentations by Dr. George Miley, Dr. Bob Bass, and Dr. Gene Mallove, all discussing cold fusion developments. Dr. Paul LaViolette discussed his new book, *Earth Under Fire*. Frank Znidarsic gave a good overview of free energy. Jack Bitterly amazed the audience with the highest efficiency energy storage medium available today: magnetic bearing flywheels. Each lecture video is now being sold for $20 so that others may relive the excitement. Audio tapes are $5 each and both are available from *Infinite Energy*. There also is the bound book, *Proceedings of COFE*, with 250 pages of papers presented at COFE. However, the real bargain that Valone and Integrity Research Institute worked on for months and has now released in a CD-ROM format is the "COFE CD-Proceedings." The CD is nicely organized by speaker name and by each day of the conference. It contains the entire 250 pages of papers on disk in addition to the entire set of lectures (two days of plenary speeches and one day of workshop presentations), about twenty-five hours in all, in RealAudio format. For the first time, the audio lectures of the entire conference can be relived from a home computer without missing anything. Even most of the slides are reproduced. Using a newly-developed audio processing technology, called the "talking CD," more speech has been stored on a CD than ever before.

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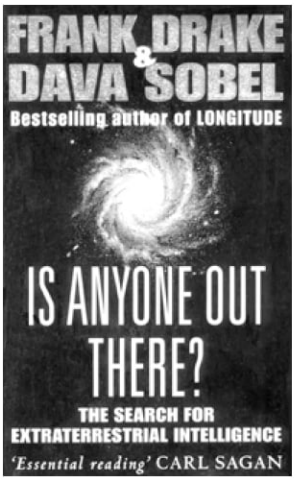
Non-Energy Times Archive

Book Review

Soo Seddon



Is Anyone Out There?
by Frank Drake and Dava Sobel
Pocket Books, 1997
ISBN 0-671-01029-8
UK £5.99* (U.S. $12. Out of print)

Although presented as a joint work by Drake and Sobel, I could find nothing in this book directly attributable to the latter. It's purely an autobiographical account of Drake's work on the SETI Project, but is nonetheless fascinating for that.

As a youngster, it was Drake's constant questioning of his intensely religious upbringing which led him to study science. He chose to attend Cornell—mainly, he confesses, because it was the only Ivy League college which admitted girls. It was there that he first looked through a telescope and became hooked on all things astronomical and also where he first pondered the question of whether, in fact, anyone was out there.

Following graduation he completed three years of naval service, then took up a research assistantship at Harvard, where he encountered the newly-emerging science of radio astronomy.

It was a terrestrial signal he mistakenly identified as originating from the Pleiades cluster that led him to believe radio astronomy would be the best way to search for extra-terrestrial signals, but he kept such opinions to himself, until in 1958, he moved to a posting at the National Radio Astronomy Observatory in Green Bank, West Virginia and nervously broached the subject of mounting a radio telescope search for ET.

His colleagues predictably fell silent and regarded him with suspicion until, to his astonishment, his Director agreed that it was a wonderful idea and allocated a budget to the new "Project Ozma" as Drake named it—the first ever SETI program.

Incredibly, Drake found an anomalous signal on Day One, a regular pulsing at eight times per second. When the telescope was moved, then realigned to the same coordinates, the signal had vanished and was never located again.

Somehow the media got wind of the event and Drake's inability to explain the origin of the signals led to accusations that he was party to a government cover-up. The Great Green Bank Conspiracy Theory still persists to this day, even though Drake is now quite sure the signal was nothing more sinister than a passing airplane.

He met Carl Sagan in 1961 at a mini-conference on how best to search for ET. Drake, charged with formulating an agenda for this meeting, did so in the form of an equation which, he believed, might be one method of calculating the possibilities of intelligent life elsewhere in the galaxy. Thus, the famous "Drake Equation" was born.

Drake still claims astonishment to see his "agenda" reproduced on T-shirts and coffee mugs and is even more amazed to find it featured in serious astronomy books and journals. Its formulation didn't, he states, "take any deep intellectual insight on my part."

Equally bemused at that Green Bank summit was Sagan when Drake expressed astonishment at the existence of several long-standing discussion groups on ET and exobiology. Drake had never dreamed so many prestigious people shared his enthusiasm for this new "fringe" science, let alone organized themselves into committees.

Sagan's explanation for his own involvement with these groups was simple. He told Drake, "I sort of glided effortlessly from attending late night bull sessions to advising the Government on the issue."

After Project Ozma finished, Drake's SETI work was put on hold, partly because of the U.S. government's preoccupation with the race to the moon, but mainly because he decided that another ET project would be professional suicide for a young astronomer keen to make a respected name for himself.

When, several years later, he became Director of the Arecibo radio telescope in Puerto Rico he had greater freedom and, by then, NASA funding.

It was a heady time in astronomical circles. Pulsars had been discovered by an English team—it was actually Drake who formulated the name, as he reckoned that "pulsating radio sources" was too much of a mouthful.

Drake was very much opposed to the burgeoning UFO culture, something which surprised many people. His approach to the analysis of SETI data was always in a highly objective, scientific manner, despite his, at times, fanatical enthusiasm for his quest.

He recalls many bizarre encounters, but all of the human kind, in the form of approaches made over the years to Sagan and himself by various eccentrics keen to explore the galaxy in person who sought their expert advice. His account of the time Sagan actually managed to convince Timothy Leary that his proposed space ark wouldn't get off the ground verges on the surreal.

Drake has his own indulgent speculations on the nature of ET civilizations. That they have achieved genetically engineered mortality is one of his pet theories, and maybe not quite such a wild one these days as it would have been considered back in the early 1960s.

Drake got an opportunity to address ET directly when he helped Sagan design the message to be contained in the Pioneer 10 spaceprobe. The now famous design featuring a naked male and female caused a real fuss at the time. Drake and Sagan were accused by one U.S. newspaper of "spreading smut through space."

Controversy and wranglings over funding appeared to go with the territory and Drake recounts several bitter battles with government officials and congressmen who believed SETI to be a complete waste of time and money but never once did it divert him from the belief that one day soon a message, irrefutably from ET, would be received.

In general, the book is an excellent overview of Project SETI up to the beginning of the decade. Unfortunately, no revisions were made when this version was reprinted in 1997, so there are several inaccuracies remaining.

On the subject of finance, Drake writes that official funding has never been withdrawn, which it sadly was quite soon after he penned that particular statement and, of course, there is no mention of the privatized SETI of the late 1990s nor of the latest huge-scale seti@home project.

In his summary of SETI's progress up to 1993, he uses Newton's analogy that scientific research into the unknown is like turning over occasional shells and pebbles on the beach in the forlorn hope that beneath one of them will lie the gem being sought. But Drake remains hopeful that with continuing research important discoveries will become less a matter of chance.

He writes: "Now we have the sieve, the minds, the hands, the time and particularly the dedication to find those gems no matter in which favorite hiding place the children of distant worlds have placed them." ❑❑❑

*Available on U.K. Amazon or contact:
The SETI Institute, 2035 Landings Drive, Mountain View, California 94043

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Millennium Media Watch

Soo Seddon

The Day the Light Went Out

On Wednesday, August 11, one million sightseers flocked to the southwestern tip of the U.K. to witness the first total solar eclipse visible from mainland Britain for seventy-two years. Undaunted by gloomy weather predictions, they raced to fill the seventy-five mile wide shadow band at a rate of 7000 cars an hour, creating thirty-five mile tailbacks on Cornish roads.

Cornwall was almost completely shrouded in thick cloud, while in the adjacent county of Devon, skies were a little clearer and many eclipse-watchers drifted northwards hoping for better views. Professional astronomers (250 of them) on the Channel Island of Alderney managed to get a glimpse of the solar corona through a short-lived break in the clouds, while passengers on a cross channel ferry unexpectedly enjoyed the best view in almost clear skies.

Despite the poor visibility, most firsthand observers still claimed even cloud-covered totality to be an uplifting experience and most described the exhilaration of watching the shadow rushing in from the west at 1600 mph as "totally spooky."

There hadn't been the expected huge advance turnout, however, and farmers who had allocated fields as temporary camping sites immediately blamed the doom and gloom merchants in the media who had put people off visiting Cornwall by claiming there would be endless traffic queues and a severe shortage of accommodation and facilities. (Some eclipse event organizers have since been forced into liquidation as a result).

Television pictures were relayed to huge monitors on the ground from an RAF Hercules circling above the clouds. A specially chartered Concorde chased totality for six minutes but several of the passengers who had paid £1500 for the flight demanded refunds when they failed to see the eclipse through the tiny windows of the aircraft.

In the rest of the U.K. it was business as usual, although most companies allowed staff to take a mid-morning break to view the partial eclipse. London's pavements were crammed with office workers all gazing skyward, wearing eye-protecting solar viewers, and looking much like a group of hopeful thespians queueing to audition for the role of the Lone Ranger. . ."What is that masked star?" The estimated cost to employers country-wide in lost working time is calculated to be £100 million.

Many great British institutions failed to remain aloof from eclipse fever. The start of the cricket at Lords was delayed by half an hour so that poor light wouldn't interfere with play. At the Old Bailey law courts judges and jurors took time out to peer at the sun, but defendants weren't permitted to join them. There were several car crashes due to viewing and driving.

Following the eclipse, the national grid reported the biggest ever power drain, 3000 megawatts as Brits made a post-eclipse cuppa or switched on television to watch reports of the moon shadow's progress across the continent.

Despite constant warnings of the dangers of looking directly at the sun with unprotected eyes, London's Moorfields Eye Hospital received over one hundred calls that day from people who believed they might have damaged their vision.

Television reports showed druids prancing around Cornish stone circles and the proceedings of several pagan weddings. The tattooed and body-pierced brigade were out in force with bell, book, candle, and video camera at the ready. There were many reports of eclipse babies, born at the exact start of totality.

Folks viewed the eclipse using welder's goggles, back projecting through pinholes or telescopes, or peering through CD-ROMs. There was even one shot of a pampered pink Hungarian poodle whose devoted owner had fastened a pair of color-coordinated eclipse viewers around his neatly-trimmed ears.

The media reportage was very similar everywhere; almost all correspondents described the light fading as though someone turned on a celestial dimmer switch, and many droned on about the insignificance of humanity and the "biblical" nature of the event.

Primaeval superstitions were awakened. Some people seriously expected the highly improbable to happen, perhaps that all the missing aircrews from World War II might suddenly appear from behind the Sun. Elvis sightings were at a premium.

Many otherwise rational people were genuinely afraid. One fifty-six-year-old Sussex man disappeared without a trace on eclipse day. He had spent the previous two years writing everyone he knew that Nostradamus was right and that the eclipse heralded Armageddon. Less dramatically, a surprising number drew their blinds and curtains and nervously waited for the moment to pass.

There was extensive newspaper coverage the next day, even in those tabloids which usually find the most obscure headlines to run rather than give prominence to the latest world event. The press interviewed quite a few "twicers," even some double twicers, who recalled the 1927 eclipse as well as the visit of Comet Halley before last.

I wasn't in the totality zone that day, but I did get a nice ringside seat at a 94% partial. There was very loose cloud cover, with only the occasional flimsy wisp to impair the view. I saw first contact. I was driving at the time and picked up my eclipse viewer when I was stopped briefly in a traffic queue. One second there was a big, proud, unsullied Sun and then, right before my eyes, the Moon helped itself to a picky, gourmet-type nibble out of its northeastern limb. I headed for home to sit in the garden and watch the slow swallowing up of our home star.

As the light gradually dimmed I found it difficult to convince myself that I was looking at a crescent Sun and not a crescent Moon. Birds became confused. They flew. . .then they stopped on the rooftops to take stock, then they flew again into the big neighboring trees where they decided to pause for a while and think about it some more. My cats were poised on hair triggers, watching and listening to the birds, and waiting. Everything appeared to be waiting. A few sensitive pond plants covered their eyes—the suspense was clearly too much for everyone.

Our "totality" was around 11:20 a.m. when all that remained of the Sun was an incandescent sliver. The previously pleasant warm morning became goose-bumpy shivery, a light breeze had sprung up, and silence had fallen very gradually, almost imperceptibly. The false twilight was amazingly beautiful, the lengthening shadows had reached their limit, and there was a surreal, slightly orange glow to everything. It was dusk and dawn combined.

It passed all too quickly; the Moon resumed its course and gave up its attempt to quench the solar furnace. Gradually the shadows shortened, the flowers opened, and the birds went noisily back about their business. It wasn't totality, but it was totally unforgettable.

The next solar total visible from the U.K. mainland will be on my birthday, 2091. I shall, of course, still be thirty-nine-years-old on that day!

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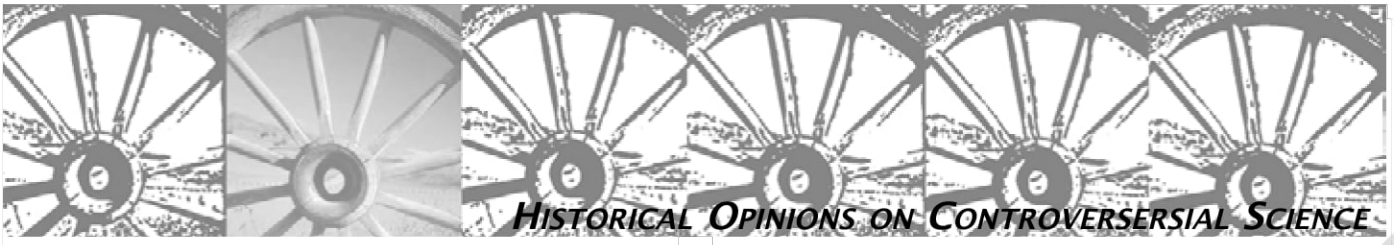


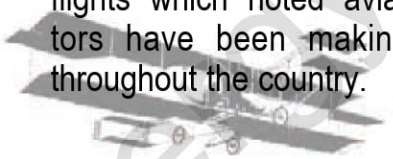
A Chat with the Editor of *Fly*, John Alexius Cleary

Reprinted from *Fly: The National Aeronautic Magazine*, January 1911, Vol. 3, No. 3

Much adverse criticism has been directed against "Johnny" Moissant and his troupe of trained aviators, now touring the country. Even my old friend, "Birdman," has seen fit to describe the company's exhibitions in the terms of a three-ringed circus performance, with the inevitable pink lemonade, peanuts and sawdust. The principal objection is that the tour of the Moissant "circus" is tending to "commercialize" aeronautics, the inference being that "commercialism" will be the saddest blow ever dealt the new sport-science, and that when it is thoroughly "commercialized" aeronautics will go down for the full count.

While conceding their absolute sincerity and ardent love of aeronautics, I take issue with the theorists who contend that the whole art of aviation will be harmed by "commercialism." I believe that this same "commercialism" has proved so far the most potent factor in the advancement of aeronautics, both as a sport and as a science. Simply because it has helped aeronautics as an industry.

They frown with displeasure upon all efforts to advance the knowledge of science, if these efforts may at the same time result in popularizing it. It is their wish to keep the field of aviation an exclusive one. Such persons have been loud in their exclamations of disapproval over the exhibition flights which noted aviators have been making throughout the country.



Suppose, for instance, the Wright Brothers had adhered strictly to their announced determination to keep aloof from the "show business," as they termed it? I should not be at all surprised if they were still carting around the elementary starting rail, whose ingenuity was undisputed in the early days, but whose crudeness in this year of grace places it among the "back numbers." The Wrights were still using the single rail at Atlantic City last July. After seeing Curtiss get away in a jiffy on his rubber-tired wheels, unassisted, the spectators at the series of exhibitions, many of whom had never before seen an aeroplane in flight, marveled at the antiquity of the Wright starting rail. To get the Wright machine in motion, it was necessary to lay the rail in an approximately straight line and to place a narrow board runway parallel with the rail and separated from the rail the distance of one-half a plane width. After the machine had been laboriously balanced astride the rail on a detachable truck, an assistant took hold of the end of the plane where the runway was placed, waited for the word "go" and then ran along, balancing the machine with his hand, until the aeroplane rose into the air. Several times at Atlantic City the truck fell into the ocean and the assistant was obliged to wade in for it.

How different from the present rapid start of the Wright biplane! And who shall say that "commercialized" exhibitions did not hasten this one improvement?

I say "this one improvement" for the reason that I believe this same "commercial" spirit has been responsible for the development of the Wright speed machine, the Wright biplane, capable of carrying several passengers, and other refinements noticed in the latest creation of the Dayton inventors.

Other creators have also profited from the much-despised "commercialized" exhibitions. In fact, it would seem to me that any aeroplane designer and manufacturer who would refuse to compare his efforts with aeroplanes of other makes, both in rest and in action, at exhibition meets, should deserve his logical fate of falling behind the science instead of advancing with every new idea.

I have advocated the so-called "commercialism" for some time past, and I am prompted to reprint here a portion of an editorial which appeared in the March (1910) issue of *Fly*.

"There are still a number of persons who decry what they term the entrance of the commercial spirit into the science of aeronautics. They frown with displeasure upon all efforts to advance the knowledge of science, if these efforts may at the same time result in popularizing it. It is their wish to keep the field of aviation an exclusive one. Such persons have been loud in their exclamations of disapproval over the exhibition flights which noted aviators have been making throughout the country. In their intense desire to make 'droming' a pastime for the few, they have been willing to stand in the way of progress by actually striving to prevent the real experiments which will result in a clearer knowledge of the principles of mechanical flight and the adoption of improvements to flying machines calculated to bring the art nearer to the mark of perfection.

"Aeronautics is not simply a sport or pastime to be indulged in by a limited number of capitalists with bulging pocketbooks. As a matter of fact, the best work already performed for the benefit of the sport has been accomplished by men who have been, in many cases, far from wealthy. Aeronautics is, primarily, a science, notable as well for its enthralling interest as for the far-reaching effects which a correct application of its principles involves. Many of the master minds of the world have turned their attention to this new science. But the field of aeronautics does not end here. It is an industry, already worldwide, which is destined to play a prominent part in future industrial life. Manufacturing plants are springing up all over and while at the present time the makers of aeroplanes and

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It is true that the War Department had found it could use certain funds it had available at the time for aviation purposes, and bought an aeroplane and a dirigible. But when Congress was asked for more money, in order that America might keep abreast of other nations in the development of mechanical flight, the appropriation was refused, on the ground that aeroplanes were of no practical value.

—Glenn H. Curtiss
Early aviator, 1910,
from *Fly, Vol. 3, No. 3*

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Alternative Catalysts for Cold Fusion

H.C. Josephs*

The use of rhodium-doped palladium has been recommended as the cathode material in a Pons-Fleischmann[1]-type electrolysis cell[2,3] and as the active catalyst in a Case-type fusion chamber.[4,5] The function of the palladium is to free the electron from the deuterium atoms and to rapidly conduct the resulting ions to the sites of nuclear activity. The function of the rhodium is to capture the deuterons or to strip the neutrons from them to allow fusion to take place within the potential well of the rhodium nucleus. The process by which this can take place is described in Reference 2.

In this paper the use of other elements as the active catalyst is examined. From the published nuclear characteristics[6] of over 2000 isotopes, a few which possess desirable properties at room temperature have been selected for comparison. Further research may disclose other isotopes which have desirable characteristics at elevated temperatures. The results indicate that only two of those selected show immediate promise of being developed into economic power sources. Included is a theory, which is not yet complete, but which nevertheless makes specific predictions that should be easily testable.

The Problem with Rhodium

Although it appears that rhodium has been the unrecognized catalyst in most if not all successful cold fusion experiments, the palladium-rhodium-deuterium system does not have the potential of being developed into an economical commercial power, or even low-level heat production system. One reason for this is that the catalysis process relies on the production of the isotope Rh-105 by the successive capture of neutrons from deuterium atoms; first by the stable isotope Rh-103 with a capture cross section, σ, of 140 barns (1b = 10^{-24} cm^2), and then by the unstable isotope Rh-104, which has a half-life of about five minutes and σ = 800b. Rh-105, with a half-life of 36.5 hours and σ = 5000b, is undoubtedly responsible for most of the heat and helium produced in electrolysis chambers using Pd cathodes, if the hypothesis regarding rhodium catalysis of deuterium is correct. This two-step production process, which includes an isotope with a short half-life, is sure to be slow and unreliable. In addition, it consumes rhodium, which in 1988 cost about $30/gram.[6]

Criteria for Selection of a Catalyst

Assuming that the cross sections for stripping a neutron from a deuteron, σ_s, and that for capturing a deuteron, σ_d, are both direct functions of the neutron capture cross section, then the foremost criterion for a good catalyst is:

1) That it have an isotope with a high thermal neutron capture cross section, σ.

2) It should also be a stable isotope so that it does not have to be produced *in situ* through nuclear processes.

3) The isotope should constitute a significant fraction of the natural element (high relative abundance) so that a large portion of the element demonstrates nuclear activity without isotopic enrichment.

4) The element itself should be fairly plentiful and relatively easy to isolate so that the cost is not prohibitive.

5) It should be chemically, physically, and electronically compatible with the host metal, which is assumed to be palladium at this time. Low chemical toxicity is desirable, but not essential, because it is expected that it will be highly diluted by the host metal.

As can be seen, Rh-105 satisfies only the first of these criteria. To compare other isotopes we will select first for those which meet the essential criteria and then compare how well they meet the others. The criterion we will use for σ is that the effective cross section, defined as the product of the isotopic cross section, σ, and the relative abundance, RA, be greater than 1000 barns. This one test evaluates the first three of the listed criteria. Thus, for example, krypton (Kr-83), which has σ = 1800b and RA = 11.5%, is eliminated because σ x RA = 207. The total effective cross section for an element is the sum of the effective cross sections for each isotope of that element. For elements with isotopes having high cross section this is dominated by the isotope with the largest cross section, that is, the other isotopes usually add only an insignificant amount to the total. The compatibility with the host metal will have to be determined experimentally, but probably will be nonproblematic because of the high dilution in the host metal. The remaining criterion, cost, is an unknown which will depend on the purity needed, demand, and the "learning curve," but for comparison we will use the published[6] costs in Table 1.

Table 1.

Isotope	σ (b)	RA (%)	Eff. σ	Tot. σ	Cost ($/gm)
Cd-113	21000	12.2	2566	2646	0.026
Sm-149	40000	13.8	5520	5900	5
Eu-151	9000	48.0	4320	4600	7.5
Gd-155	61000	14.8	9028	49000	0.48
Gd-157	255000	15.6	39780	49000	0.48

Gadolinium (Gd) is listed twice because it has two stable isotopes which meet the criterion that the effective cross section be greater than 1000b. Of the "traditional" ninety-two elements, only the four listed meet the effective σ and stability criteria. Gadolinium is the obvious winner of the cross section contest, while cadmium has the advantage of the lowest cost. If the only reaction were the capture of a neutron to form the next higher mass isotope, then Cd-113 could produce about 200 kWh per gram of cadmium if all the Cd-113 were converted to Cd-114. Under similar assumptions gadolinium would produce about 300 kWh per gram at about twenty times the cost of the "fuel." However, if the catalytic process proposed earlier does in fact occur, then both elements should produce orders of magnitude more heat per gram consumed.

The presence of natural impurities can lead to confusing results, as a small concentration of a substance with a high neutron capture cross section could produce a burst of unreproducible activity with quick burnout. Two samples of 99.9% pure Pd were obtained from the same supplier,[7] one in 1989 and the other in 1993. The trace impurities in these samples are listed in Table 2. The only two elements which have isotopes with capture cross sections greater than 20b are Pt-190 with σ = 800 and Ca-42 with σ = 40. The relative abundances are 0.01% and 0.64% respectively. The Pt-190 could cause a burst of activity with very quick burnout, because of

Table 2.

1989 Sample (ppm)		1993 Sample (ppm)	
Si	430	Fe	35
Pt	70	Ca	10
Fe	45	Ni	6
Ti	2	Zr	6
Mg	0.7	Si	3
		Cu	2
		Ti	0.4

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the high cross section and low abundance. The activity reported in Reference 2 used material from the 1989 sample. This activity was assumed to not have been due to Pt-190, because the activity stopped due to mechanical vibration, not of its own accord.

Impurities less abundant than 0.4 ppm were not reported, so it is possible that rhodium, for example, was present in either sample in concentrations of 400 ppb or less. Even if this was not the case, Rh-103 may have been produced by neutron stripping and capture by Pd-102, followed by β-decay of Pd-103 to Rh-103.

Neutron Stripping and Deuteron Capture

The proton and neutron in a deuteron are held together by a very low binding energy, 2.225 MeV.[8] When a deuteron approaches another atomic nucleus, the proton and neutron come under the influence of two opposing forces. The proton is repelled by the Coulombic force of the positively charged atomic nucleus, while both particles are attracted by the nuclear strong force. At distances where the Coulombic force exceeds the strong force, the deuteron is subjected to net forces which tend to tear it apart. The strong force increases much more rapidly with decreasing separation of the nuclei, so a point can be reached where the combination of the two forces exceeds the binding force of the deuterium nucleus. At this point, which will occur at distances less than the free thermal neutron capture radius of the isotope in question ($\sigma_s < \sigma$), the neutron will be pulled into the nuclear potential well and the proton will be ejected.[8] In vacuum the deuteron must have kinetic energy in excess of the deuteron binding energy for this to happen. In a metal near a nuclide with large neutron capture cross section, the neutron may be extracted while the proton is still hundreds of fermis (femtometers) distant and still well outside the innermost electronic orbits of the host metal. (Note that Gd-157 has a capture radius of 2849 fm, compared to 400 fm for Rh-105 and 817 fm for Cd-113). The energy to split the deuteron is supplied by the binding energy of the nuclide. The work done on the deuteron by the strong force as the deuteron moves toward the catalyst nucleus must exceed the binding energy of the deuteron.

When a deuteron approaches another atomic nucleus closely enough that the strong force exceeds the Coulombic repulsion on the proton minus the binding force of the neutron, then the entire deuteron will be captured and a compound nucleus[8] will be formed. A compound nucleus is a loose assemblage of two nuclei, with the smaller essentially within the outer skin or "halo" of the larger. This assemblage can exist for at least 0.1 fs (femtoseconds) before the nuclides readjust their energies and orbits to form a new nuclide. When the central nuclide has a large capture radius, although $\sigma_d < \sigma$, the deuteron may be captured while it is far enough away that there is still considerable electron shielding. If during the next 0.1 fs or so another deuteron is available to be captured, and actually is captured, the conditions for the fusion of the two deuterons have been met, an alpha particle is ejected and the nuclide is returned to its original condition. This is the proposed nuclear catalytic process.[2]

Thermal Neutron Capture Cross Section

The thermal neutron capture cross section of an isotope is defined as the area of an opaque disk which would block the same fraction of a beam of neutrons as a single atom of the isotope would capture from the beam if the neutrons had a velocity of 2200 m/s. This corresponds to an energy of 0.0253 eV or the energy of randomized neutrons at a temperature of 300°K. The radius of the disk, given by $r = (\sigma/\pi)^{1/2}$, is the effective radius beyond which no neutrons would be captured. That is, a sharp edge is assumed below which all neutrons are captured and beyond which none are. The real situation is more gradual, so that some neutrons are captured well beyond the capture radius. In addition, because the cross section is measured with a one dimensional flow of neutrons, the number of neutrons captured is assumed to be equal to σ times the neutron flux density (neutrons/cm^2/sec). In a solid, however, the neutrons would be randomized and would approach from all directions. This would result in the fraction of neutrons captured being $\sigma/4\pi r_d^2$, where r_d is the average distance between the neutron source and the catalyst nuclide. In palladium this would be the distance between the catalyst and the deuterium nuclei. At 0°K the deuterons form a sublattice between the Pd atoms so the value of r_d is about half the Pd lattice spacing $a = (M/\delta N)^{1/3}$, where M is the atomic weight of Pd (106.42), N is Avogadro's number, and δ is the density of the host metal. Thus $r_d \approx 0.1$ nm.

Assuming a cubic arrangement for the deuterium atoms, each central nuclide has 8L nearest-neighbor deuterons where L is the deuterium loading factor. The time required for one deuteron to traverse its distance to the nuclide is r_d/v. The average velocity of thermal deuterons is $v = (3kT/m)^{1/2} = 1900$ m/s, where k is Boltzmann's constant, T is the absolute temperature, and m is the mass of the deuteron. Thus the maximum deuteron flux, $\varnothing$, the number of deuterons per second which can impact the deuteron capture "disk" of the central nuclide is:

$$\varnothing = 8L\sigma_d v/4\pi r_d^3. \quad (1)$$

We will assume that the splitting cross section and the deuteron capture cross section are direct functions of σ, $\sigma_s = f_s(\sigma)$ and $\sigma_d = f_d(\sigma)$. If the functions are linear then $\sigma_s = s\sigma$ and $\sigma_d = d\sigma$, where s and d are constants such that $d < 1$ and $s < 1$, but the relationship between s and d is unknown. We can now evaluate the maximum number of free thermal neutrons that would be captured by the central catalyst and then multiply by Ls or Ld, as appropriate, to obtain the maximum rate at which neutrons could be acquired by splitting deuterons or the maximum rate that deuterons could be captured. The reciprocal of this number gives the minimum time between neutron or deuteron captures by the nuclide. Doing this with L and d having their maximum value of one yields the minimum time between captures by Gd-157, $1/\varnothing > 4$ ps, and for captures by Cd-113 the time is $1/\varnothing > 49$ ps at room temperature. As these times are orders of magnitude greater than the few tenths of a femtosecond expected for the lifetime of a compound nucleus, this analysis indicates that the lifetime of compound nuclei formed on some isotopes must have longer lifetimes than those reported for light nuclei.[8] This conclusion is based on experimental results[10] showing the production of He-4 in cold fusion apparatus. Neutron capture alone produces hydrogen and much less heat. Hydrogen is produced because a proton is ejected when a neutron is stripped from a deuteron. The heat produced is the binding energy per nucleon of the catalyst minus the binding energy of the deuteron, ≈ 6 MeV per capture. Each neutron capture destroys a catalyst atom. In d-d fusion about 24 MeV is produced per fusion reaction and the catalyst is preserved to catalyze another fusion reaction.

The neutron capture cross section is roughly inversely proportional to the neutron velocity,[9] but at certain temperatures, which are different for each element and for each isotope of that element, the cross section may increase greatly. These increases, called resonances, are determined by the energy levels and spacing of the nuclear energy states[8] in the nuclear halo. The effective cross section for cadmium, for example,[9] decreases slightly from room temperature, then increases to about 3500b at 900°C (0.1 eV) and continues to increase up to 7000b at 2000°K (0.17 eV) as it approaches resonance. If this resonance is due entirely to Cd-113, then the 7000b effectively corresponds to 57,000b isotopic. Thus cadmium may perform better at the temperatures necessary for electrical power generation.

The temperature behavior of the cross section for gadolinium is

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not given, but judging from its magnitude, it is probably at or near resonance at room temperature. Since the resonances for the heavier elements are generally narrower and closer together, gadolinium may prove to be more temperature sensitive than cadmium. It may be necessary to control the temperature to match one of the resonances. Another possible technique would be to adjust the conductivity of the electrolyte in an electrolysis cell so that the potential difference between the electrolyte and the cathode causes the energy of the surface deuterons to match one of the resonances. One way to insure that this happens would be to operate the electrolysis cell with a half-wave rectified voltage wave rather than DC. The peak voltage can be set above the highest expected resonance so that the instantaneous voltage will sweep through the desired voltage 120 times per second.[2] It should be possible to determine the critical voltage by observing the instantaneous voltage at the time when bursts of gamma rays are emitted. Although the d-d fusion process is not expected to produce gammas, neutron capture produces a broad spectrum of gammas in vacua. In deuteron splitting and neutron capture, the energy and intensity of the gammas should be greatly reduced, as the proton should carry off the majority of the energy. X-rays will be produced by occasional energetic ionization of atoms of the host metal by the protons or alpha particles. However, most of the proton interactions will occur with the outer electrons of the host, and will be dissipated as heat. A few 3.2 MeV neutrons (4 MeV for Cd-113) will also be emitted, because occasionally the catalyst will absorb the proton and eject the neutron.

Reaction Rates

For simple neutron capture the reaction rate is determined by the deuteron flux multiplied by the number of catalyst atoms present. From Equation (1) this is:

$$\varnothing_n = 8Ls\sigma n\ RA\ N/4\pi r_d^3 A \qquad (2)$$

where n is the atomic concentration of the catalyst and A is the atomic weight of the host metal. For cadmium at a concentration of 1 ppm this is 1.77 (10^{24}) Ls neutrons per second per gram of palladium. This reaction rate would consume all the Cd-113 in a few microseconds. What this calculation means is that the reaction rate will be controlled by the rate at which deuterium can be loaded into the palladium. The Ls product will remain small and the deuterium and Cd-113 will be consumed as rapidly as deuterium is loaded. This would mean that in an electrolysis cell the reaction rate could be controlled by the current. Shutting down the reaction would only require turning off the current.

Since neutron capture yields 200 kWh per gram of cadmium, the cost of the cadmium is negligible. The cost of the palladium however ($4/gm) would be prohibitive even if the concentration of cadmium could be as high as one atomic percent. The palladium is not consumed, but would have to be recharged with cadmium periodically. Perhaps a pure cadmium cathode in sponge or powder form would work in an electrolysis cell.

Gadolinium would be too expensive to be used as a nuclear fuel, but would be appropriate if the catalytic process works. The key is the lifetime of the compound nucleus. The lifetime must be long enough to allow the capture of a second deuteron before the catalyst nucleus absorbs the neutron and ejects the proton, or vice versa. The fraction of deuterons arriving within 0.1 fs of each other would be of the order of the lifetime over the average time between arrivals, 0.1 fs/ 4 ps, maximum. Thus the rate of capture of pairs of deuterons would be 5 (10^{20})/s or less. It appears that competing neutron captures would dominate the process. Only about one in forty thousand deuterons would be available to be captured. Even if the deuteron splitting and deuteron capture cross section were equal and the lifetime of the compound nucleus were seconds long, the rate of consumption of the catalyst would only be reduced by 50%. For the use of gadolinium to be practical, the deuteron capture would have to be considerably more likely than splitting. This is not unreasonable, as the deutron would probably have to be captured before it is split.

Conclusions

It would appear that even if the proposed catalytic fusion process does not work, cadmium-doped palladium used in a system such as the Case reaction chamber may prove to be economically satisfactory, especially if the palladium could be eliminated or replaced by a less expensive metal. The Case process eliminates the need for heavy water, and permits the use of operating temperatures closer to the cadmium resonance without the need for extreme pressure. The cadmium serves as the fuel and the deuterium supplies the neutrons. The palladium is essential to ionize the deuterium and still leave it mobile. A metal which forms a true hydride probably would not have a high enough deuteron mobility to work. In an electrolysis cell the deuterons are generated in the electrolyte and are available for reactions at the surface of the cathode. The cathode voltage can be controlled to gain access to resonances at energies greatly in excess of those available by simply raising the temperature.

If the lifetime of the composite nuclei (Cd-113)-(H-2), (Gd-155)-(H-2), or (Gd-157)-(H-2) is long enough to make the catalytic fusion process work, then the economic and environmental wisdom of using either cadmium or gadolinium as a nuclear catalyst will depend on how fast the fusion reactions occur. It may be that Rh-105 is the only nuclide with a sufficiently long lifetime and deuteron capture cross section to sustain catalytic action.

If neutron stripping is more likely to occur than deuteron capture, the catalyst will ultimately be consumed by being converted to a more massive, but nuclear inactive, isotope. If this should be the case, the least expensive and most plentiful catalyst, namely cadmium, would be the material of choice.

I regret not being able to participate in the experimental aspects of this work. On relocating from Minnesota to New Mexico I lost access to a laboratory. I must therefore rely on those who are still active in experimentation to complete the study begun here.

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Suggestions for Improving Cold Fusion Reliability

Harold C. Josephs*

Introduction

A sequence of nuclear reactions has been proposed[1] which appears to explain many of the observed experimental results[2,3] in Pons-Fleischmann-type cold fusion electrolysis chambers. The model suggests that rhodium, either naturally occurring as an impurity in palladium or produced through neutron capture by palladium or intentionally added to the palladium, captures additional neutrons and deuterons. (Rh-105 is known to have a very large capture cross section for thermal neutrons, 5000b. The only isotope which I have found with a higher capture cross section is Cd-113.) The captured neutrons and deuterons are then capable of combining very quickly with each other within the nuclear "halo"[4] of the rhodium nucleus. The energy released by this reaction then ejects the daughter particles, which transfer their energy to the electrons of the host metal. The rhodium is not consumed in the process but, like a catalyst, facilitates the production of heavier nuclides from deuterium. The function of the host metal is to bring the deuterium ions into close enough proximity that they can be captured by the rhodium. The fusion does not take place by direct d-d contact, but by an initial splitting of the deuterium, and capture of the neutron. This process is repeated to create Rh-105 from the original Rh-103. These neutron captures are then followed by the capture of one or more entire deuterons by the neutron-hungry Rh-105. Based on this proposed model for cold fusion, one can make suggestions for improving both the reliability and reproducibility of the process, including those used by Dr. Les Case in his experiments.[5,6] Several of these suggestions have already been proposed by others,[7] based on conclusions they have drawn from their experimental work. For a discussion of alternative theories of cold fusion, see the summary by Dr. Edmund Storms.[8] Regardless of the experiment being performed or the theoretical model being tested, it is desirable to minimize the effects of uncontrolled and unknown variables by eliminating them to the greatest extent possible.

The Case Catalytic Fusion Process

In the preferred embodiment of Dr. Les Case's[5] process for the coproduction of energy and helium from deuterium, activated carbon with up to about 1% finely divided palladium is exposed to deuterium gas under about two atmospheres pressure at around 200°C. An increase in the temperature of the reaction chamber occurs when the D_2 gas is added, which is not observed with H_2. When the gases in the chamber are analyzed, He-4 is found in concentrations considerably above those which could be accounted for by leakage from the atmosphere. The chamber, including the solid catalysts, is initially cleaned with hydrogen at temperatures above 100°C. The hydrogen is evacuated before introducing the deuterium. It is reported that platinum and rhodium also show some effectiveness in producing heat when used as catalysts.

As has been shown,[1] palladium does not have suitable nuclear properties to participate in any rapid nuclear processes. Neither does it have chemical, physical, or electronic properties which could initiate or sustain nuclear processes including direct d-d fusion. It does, however, have the ability to produce rhodium through neutron capture and β-decay of Pd-102. The process is inherently very rare, but rhodium is sometimes found as a natural impurity in palladium and platinum. Pure rhodium does not appear effective when it is used as the cathode in an electrolytic cell.[9] Palladium is believed to have a more favorable crystalline structure than other host materials for promoting the capture of neutrons or deuterons by rhodium. Thus, even though the catalyst in Dr. Case's reactions is not palladium or platinum but more likely rhodium, he appears to have evolved an effective method of bringing deuterium rapidly to the rhodium sites in microcrystallites of palladium. Even if the palladium crystallites were only one micron in dimension and the rhodium concentration were only 1 ppb, the probability of finding one or more rhodium atoms in a microcrystallite is close to 100%.

Suggestions for Improvement

As was pointed out earlier, in the rhodium-catalyzed fusion model the fusion reactions depend entirely on the presence of Rh-105 and the diffusion of deuterium through the palladium to the locations of the rhodium atoms. Anything that will impede or prevent the diffusion will slow or stop the fusion processes. The mobility of deuterium in palladium will be decreased by dislocations, grain boundaries, cracks, and impurities. The amount of deuterium available to participate in diffusion will be determined by the "loading factor" and by the presence of normal hydrogen. Thus, the preparation of the material and design of the reaction chamber will have very strong effects on the results of fusion experiments.

Hydrogen and deuterium ions are the smallest of ions. Being naked atomic nuclei, protons and deuterons respectively, they are smaller than other ions by a factor of about 100,000. Except for their opposite charge and much greater mass, they behave much like electrons. They are not bound to the metallic lattice, but are free to move through the interstices in the crystal. The accompanying electron is not closely associated with the ion, but behaves like part of the "electron sea" of the host metal. Like electrons, the ionic motion will be scattered by disruptions in the crystalline structure of the metal, such as impurities, dislocations, and grain boundaries. Sheet palladium that has been prepared by rolling or hammering has been work-hardened by the production of a microscopic grainy structure in the metal. The grain boundaries not only make the metal less ductile and malleable, but decrease the mobility of the electrons, deuterons, and protons. Impurities and dislocations will have similar effects. Annealing will restore the ductility and malleability of the metal by allowing the palladium atoms to return to their lowest energy state, reducing the number of such defects. Perhaps the finely divided metal particles used by Dr. Case are smaller than the grains so that annealing is not needed. The palladium used in other fusion experiments should be annealed. The optimum annealing temperature and time will have to be determined.

Cracks are long narrow voids in the metal. Ordinarily they are not long enough or wide enough to be visible to the naked eye. However, when fusion is taking place at the location of a single Rh-105 atom, a large amount of heat is being rapidly produced in an extremely small volume. This heat will cause a correspondingly large amount of thermal expansion in the local volume. The accompanying strain of the surrounding metal will cause any cracks in the vicinity to propagate, resulting in the likelihood of a tiny metal flake containing the "hot spot" being dislodged from the surface, electrically disconnecting the material from the ion source. To minimize this flaking, the cathode material should be as crack-free as possible. This would probably not be a problem in Case's process, since electrolysis is not used.

If the reaction is allowed to continue at a high power level, the temperature of the hot spot can rapidly rise to the melting point or even to the boiling point of the palladium, creating a tremendous amount of thermal and mechanical stress on the metal. The melting or vaporization of the metal can cause the rhodium to be ejected along with a microscopic quantity of palladium, leaving a pit. When this happens the fusion reaction will stop. Ways must

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be found to control the reaction rate or to provide for the very rapid removal of heat from the point of the reaction.

In an electrolysis chamber, sources of impurities, in addition to those present in the cathode, are: the anode material, the wires, solder and insulation used for electrical connections, the materials of temperature sensors, stoppers, sealants, and the walls of the reaction chamber itself. It appears that pure platinum should be used for the anode and all wiring. Electrical connections should be welded or tightly crimped. Insulators should be Teflon or fused quartz. Stoppers and seals should be teflon or silicones. The temperature sensors should be tested for any signs of corrosion in the reaction chamber. The reaction chamber itself should be of fused quartz. Certain types of stainless steel are non-corrosive, but others have been noticed to discolor when placed inside an electrolysis cell. Most of these problems do not affect the Case process, because ions are not created until the deuterium has been absorbed by the palladium.

Impurities consisting of atoms having a different radius than palladium constitute a dislocation in the metal lattice. This dislocation will extend over many lattice constants if the impurity atom occupies a substitutional site in the crystal. If the impurity atom occupies an interstitial location in the crystal, the dislocation of the lattice will extend over a greater volume of the crystal. Annealing will alleviate this problem, because it allows the impurities to move from interstitial to substitutional positions. Because any impurities will decrease the mobility of the deuterons, one should begin with the most pure palladium available. An impurity concentration of one part per million corresponds to a concentration of one impurity atom per 100 palladium atoms in each of the three space directions; it would therefore appear that this would be approximately the maximum impurity level permitted. If any impurities, such as rhodium, are to be added, the concentration should be as low as practical and they should be added prior to the annealing process. If the host metal is finely divided or porous, the deuterium ions have a much smaller distance to travel, so ionic mobility is less of a problem.

Probably one of the most common impurities in palladium is hydrogen. Fortunately the annealing process will release the hydrogen if the annealing is done in vacuum or an inert gas, such as argon. After annealing, care must be taken to exclude all hydrogen from the system. The D_2O, in particular, must never be exposed to the atmosphere. Pure D_2O is extremely hydroscopic and will quickly pick up an equilibrium concentration of H_2O, if exposed to air. The hydrogen has a higher mobility than deuterium, both in the electrolysis chamber and in palladium, and will be loaded in preference to deuterium. The more hydrogen there is in the palladium, the less room there will be for deuterium, and the lower the deuterium "loading factor" will be. It is important that the reaction chamber be closed and pressurized or flushed with, say, dry argon or deuterium gas. The Case process accomplishes exactly the desired effect.

In summary, one should begin with the most pure and crack-free palladium possible. Any experimental additives, such as rhodium, should be added, perhaps by ion implantation, to a concentration of 1 ppb to 1 ppm. The palladium should be annealed after all preparatory work is completed by heating to near its melting point and cooling it slowly in a dry, inert atmosphere. The anode should be of as pure platinum as is practical. Electrolysis cells should be designed so that the heavy water is never exposed to the atmosphere, and atmospheric air cannot enter the reaction chamber. All materials in contact with the electrolyte should be corrosion resistant. All parts of the reaction chamber should be absolutely dry before and during assembly. Venting of the chamber should be done through an oil bubbler or equivalent. The electrolysis should be conducted under constant power input conditions as described earlier.[2] Regardless of the experiment being performed or the theory being tested, standardizing the experimental conditions and minimizing the number of uncontrolled variables is desirable. If these precautions are followed by all experimenters, our experimental results should begin to agree. The Case process accomplishes or has no need for most of these precautions. It would be desirable, however, to standardize the concentration of rhodium in the palladium at some point during the manufacture of the "catalytic" mixture. I would also like to see a measurement comparison of the temperature rise of the reaction chamber with H_2 versus D_2 without any catalyst in the chamber.

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About the Author

Mr. Josephs has published more than two dozen technical papers and served on technical and political committees. He retired from academia in 1990 and has engaged in cold fusion research since 1989.
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Please see *IE* Issue No. 27, p. 72 for more complete biographical information.

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Quote from P. W. Bridgman, The Thermodynamics of Electrical Phenomena in Metals, Dover Publications, NY, 1961, from the Introduction, starting on p. 1 (Originally copyrighted in 1934). Bridgman was the Nobel Laureate in physics in 1946.

The progress of physics is unsystematic. . . The result is that physics sometimes passes on to new territory before sufficiently consolidating territory already entered; it assumes sometimes too easily that results are secure and bases further advance on them, thereby laying itself open to future possible retreat. This is easy to understand in a subject in which development of the great fundamental concepts is often slow; a new generation appears before the concept has been really salted down, and assumes in the uncritical enthusiasm of youth that everything taught in school is gospel truth, and forgets the doubts and tentative gropings of the great founders in its eagerness to make applications of the concepts and pass on to the next triumph. . . But each new young physicist . . . is in danger of forgetting all the past rumination and present uncertainty, and of starting with an uncritical acceptance of the concepts in the stage of development in which he finds them.

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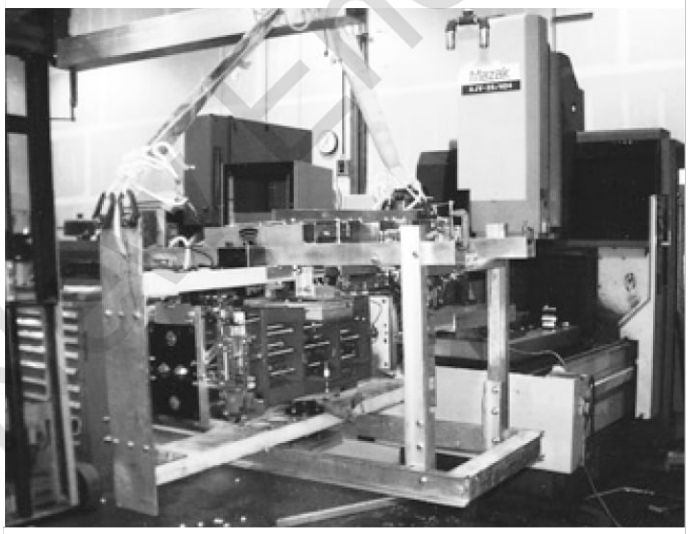
Robert Cook's CIP Engine Test Impresses Engineers at Boeing Aircraft

Press Release From Robert Cook, June 21, 1999 (Edited by E. Mallove)

Robert Cook, inventor, revealed a successful series of "strain gauge" tests conducted on his latest CIP (Cook Inertial Propulsion) model in Seattle, Washington by Boeing personnel. The first series of tests were conducted early in December 1998, and a later series in May 1999. The tests showed positive results. One more series of tests will be required before Boeing decides on whether to further develop this unique inertial propulsion system. The future tests will entail what is known as a "pendulum test," where the CIP unit will be suspended on forty-eight-foot-long ropes to see if it will deflect off center when it is turned on. These tests will probably take place in July or August of 1999. [*Editor's Note: Mechanical problems were said by Robert Cook to have prevented this pendulum testing from going to completion.*—EFM]

These Boeing tests are the second time that a large company has professionally tested Cook's propulsion ideas. In 1971, United Airlines in San Francisco did a "dynamics" study on an early model of the CIP system which proved that the system worked. Another very sophisticated test in 1972, conducted by United's engineering staff headed by Eb Jensen and David Doll, also proved that the principle of the CIP engine was sound. This test was called an accelerometer test and required several weeks of testing.

Another noteworthy test was a computer model tested by computer expert Dr. Paul C. Mitiguy at Knowledge Revolution in San Mateo, California on March 20, 1997. This test also showed that the principle of inertial propulsion worked. Testing of CIP models by professionals has always brought about positive results and proves that certain laws of science are not one hundred percent true. The laws in question are Newton's third law of motion (action-reaction) and John Wallis' "Conservation of Angular Momentum," laws which Newton took credit for. The controversy over the breaking of these laws by Cook's invention has made many scientists (who have never seen any of the working models) believe that Cook has hypnotized or drugged the scientists and engineers who have, after testing successful models, declared the Cook principle to be "revolutionary" and possibly the greatest invention in the history of the world.



The preparation of the Cook Inertial Propulsion System for the actual "strain guage" test on May 27, 1999. *Photos Courtesy Robert Cook*

The Surprise at Boeing

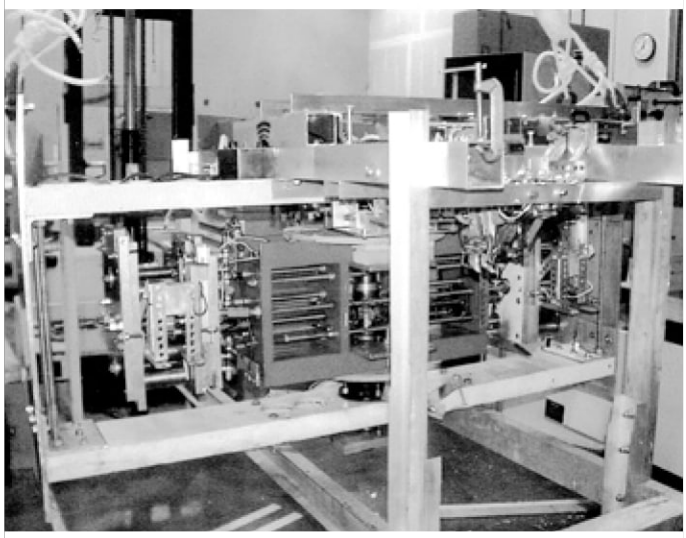
When Robert Cook and his wife, Scherl, took a working model of the CIP engine to Seattle, Washington in December 1998 (for the first time) for testing by Boeing engineers, there was much laughter when this two-rotor unit was unloaded. The model was very crude by Boeing standards and it was to do what many thought was impossible. This model, consisting of a four-foot diameter arm (which was run up to a very slow 10 rpm), had two small rotors attached to each end of the arm (these were run up to 80 rpm) and they had to pick up a series of five pound weights (one at a time), spin them for 180° of arm travel, and then eject them without smashing them while maintaining a constant speed. The smoothness of this action of picking up such heavy weights without stopping led one of the witnesses to say, "Even if this thing didn't propel, what it is doing is nothing short of miraculous—we have never seen anything so amazing!" Three days were spent on these tests.

A second series of tests were conducted on an improved model in May 1999 with arm speeds of 22 rpm and rotor speeds of 176 rpm. The weight exchanges on these tests were so smooth that no noticeable sound or shock of any kind was made. Even the strain gauge failed to detect any disturbance from the exchange.

Five executives from Boeing who saw some of the testing liked what they saw and want further tests to be conducted as soon as more modifications are made to the model. These next series of tests will require 30 to 50 rpm for the arm and 250 to 400 rpm for the rotors. The impulses thus far generated by this model are only around three pounds for the early tests and the final series are expected to show around ten pounds or so. According to Cook, a precision system built by the Boeing group could easily spin at speeds that would generate over 20,000 pounds of force, and when fully perfected the future forces generated could prove to be "mind boggling."

What This Invention Could Do

In the not too distant future we could see electric cars which would have tremendous range and require very small batteries instead of the 2,000 pounds of batteries most electric cars now



Continued Testing of the Cook Inertial Propulsion System at Boeing in Seattle, Washington between May 25 and 27, 1999.

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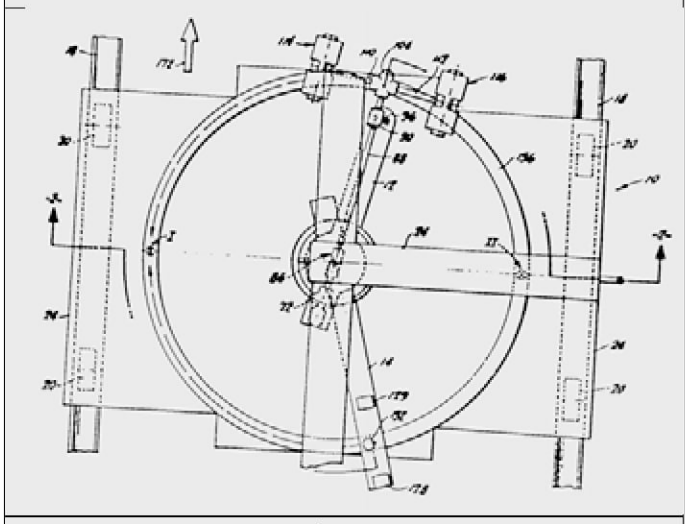
Device for Conversion of Centrifugal Force to Linear Force and Motion
U.S. Patent No. 4,238,968, Dated Dec. 16, 1980



Abstract

A device to employ centrifugal force for use as linear motion utilizing a pair of counter rotating arms about a common axle. One arm contains a mass splitable and transferable to the other arm and back again at 180° intervals. The device may include a surface travel system, or two of such devices may be employed in tandem for any mode of travel.

require for their seventy to ninety mile range before recharging. We could also see wingless flying craft capable of circling the earth in two hours or less. These could be either cigar or saucer shaped. Mining of the moon and planets, as well as their colonizing, could become possible. A thorough study of this new propulsive principle could lead to the full understanding of how gravity and magnetism work.

Appendix to the Press Release

Boeing is the second notable company to see successful results from tests conducted on Cook's invention. In 1971, United Airlines (UAL) engineering department, in San Francisco, tested an early model of Cook's invention for several weeks. A "dynamics analysis" report prepared by David Doll stated: "On September 10, 1971, Robert Cook brought to UAL a device designed to convert centrifugal force into a linear thrust. In spite of being declared in violation of the laws of motion by the U.S. Patent Office, Cook's crudely-built rig moved spasmodically across the floor."

The twenty-eight page report went on to show mathematically why the system worked and how it could be improved. In 1972, an "accelerometer test" at United Airlines test facilities (which took several weeks to perform) gave further proof that the so-called "impossible" unidirectional force system worked. How it worked was very plainly explained in paragraph three, page two of their earlier report D-71-77 dated September 10, 1971, where it states:

"During this portion of the cycle the system acts as a mechanical analogue of a rocket. The propellant mass is accelerated in the aft direction by the spring force, and the resultant reaction produces a forward thrust upon the cart. In addition to this reaction force there is Coriolis force, which is the inertial effect occurring when a mass is constrained to move in a straight line across a rotating body."

One of the other interesting things mentioned in that report was a suggestion on how to improve the performance of the system. "A significant improvement can be achieved by using viscous damping to arrest the propellant mass. Not only can the large negative impulse be avoided, but by delaying the travel of the mass to the end of the track, the negative centrifugal force component can be reduced. . . Cook's cycle could also be improved by the use of a constant force, rather than the variable spring force to accelerate the propellant mass. This would increase the thrust during the ejection stroke by allowing the use of greater force and improving the timing of the stroke."

After the accelerometer testing was completed, the engineers at United Airlines' testing facility were satisfied that the CIP principle worked in spite of what Newton's laws and the U.S. Patent Office said. The Patent Office later changed its mind and issued Cook a patent in August of 1972 on the system tested by Jensen and Doll [U.S. Patent No. 4,238,968, dated December 16, 1980].

Eb Jensen and David Doll knew that the scientific community would not accept their reports, and both were quoted as saying that they would stand by their work. When they were questioned about whether they believed the CIP principle had been proven to their satisfaction, they never backed down and have always stated that they believed that the results of the successful testing were true and correct—the CIP principle worked! Many years after their acceptance of the new propulsive principle, Jensen and Doll stood by their belief that Cook had done the impossible. David Doll went on to become the head of the UAL Jet Engine Maintenance Department.

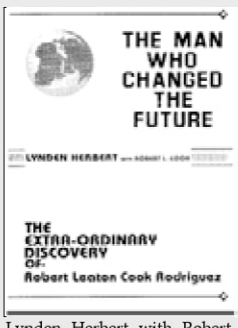
In late 1990, a computer model of the CIP was set up and tested by engineers at Hughes Aircraft in the Los Angeles area. The first three runs of the computer model showed positive results, but, unfortunately for Cook, the computer programmer refused to accept the positive results. He could not bring himself to believe that Newton's laws had been broken, so he proceeded to alter the program until he received the answer he wanted—zero net force. Scientists and engineers, who later saw how the program had been altered, all agreed that this was not Cook's principle but a make-believe, magic torque machine which did not represent the real world. Pure sabotage! This test had originally shown not one, but two different internal, unidirectional forces.

Cook—See page 70

About the Inventor

Robert Cook was born in Presidio, a small town just north of the Mexican-American border in Texas, on March 1, 1934. Spanish was Cook's first language. He learned English when he was eight years old. He lived in a three room adobe house with his parents, aunts and uncle, three brothers, and one sister. As a young man in his teens he began learning mechanics through the hands-on experience of making repairs of all types to motorcars. When he was barely seventeen, he learned the printing trade, where he gained mechanical experience that would later prove invaluable to his creation of the Cook Inertial Propulsion engine.

Cook has now been working on his CIP project for thirty-one years. He is co-author of two books: *The Death of Rocketry* with Joel Dickinson, and *The Man Who Changed the Future* by Lynden Herbert (Professor of Oxford and Cambridge and grandson of Sir George Herbert—"The Fifth Earl of Carnarvon"—who is famous for funding the expedition that discovered King Tut's tomb). Cook has been married for twenty-three years to his wife Scherl. They have four sons: Robert, Victor, Benjamin, and Joseph. In his free time he likes to fly. He earned a pilot's license and has logged about 2000 hours flying various airplanes. He enjoys both listening to and playing music. He can play the guitar and various brass instruments. Cook hopes to develop two more inventions—a water purification device and a non-polluting energy production system. The most important of all his goals is to publish his soon-to-be-finished book, *God's Demonstrations*.
Address: 4429 Holly Street, Guadalupe, California 93434 Phone: (805) 343-0804.



Lynden Herbert with Robert Cook, *The Man Who Changed the Future,* CIP Press, P.O. Box 454, Los Alamos, California, 93440, ©1995, 206 pages, illustrations, ISBN 1-887397-00-0.

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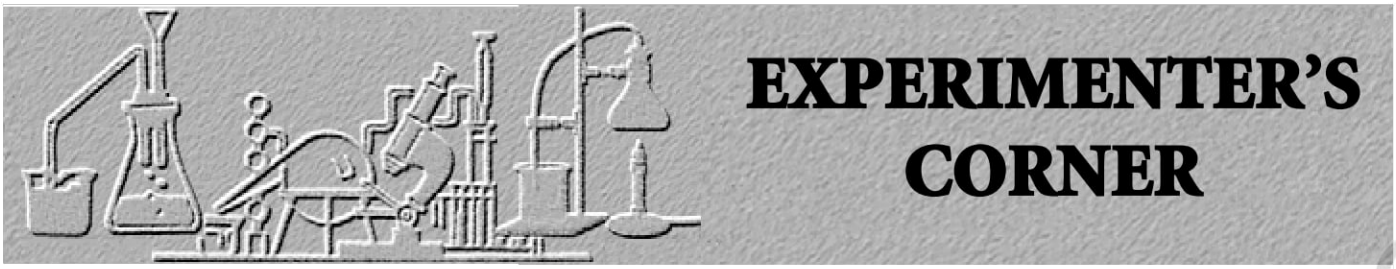
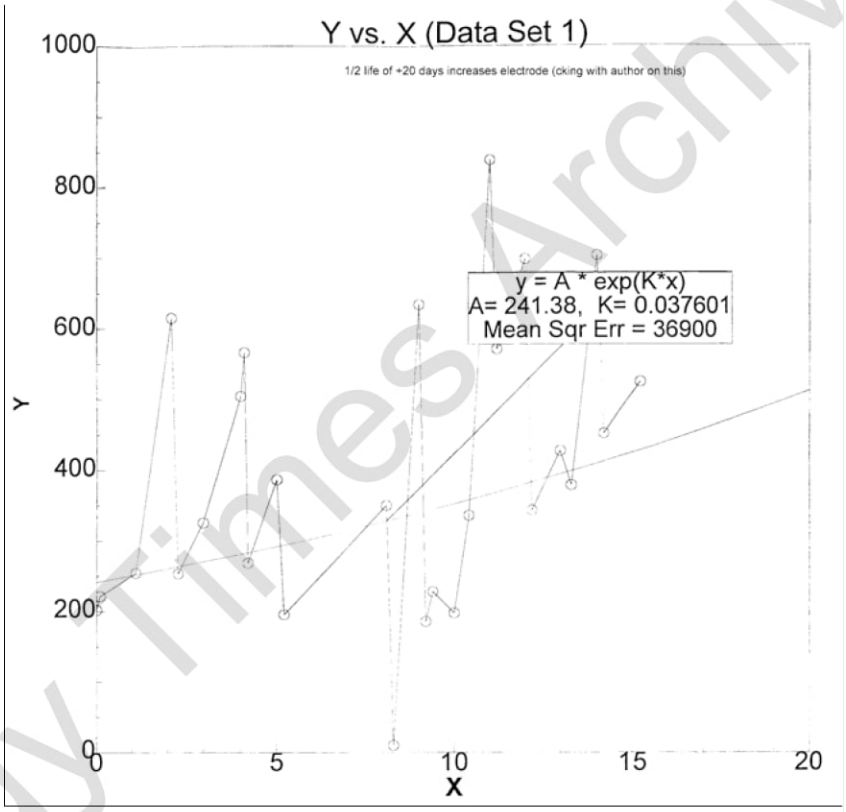


More on "Increasing Radioactivity"

Robert Schultz and John Kenny kindly sent in this intriguing graph of experimental radiation data from their cold fusion cell experiments. It is a very interesting phenomenon, if real. It might have some connection with the work of George Sassoon and his "Radioactivity in Welds"—see *Infinite Energy*, Issue No. 27, pp. 47-48. Incidentally, Sassoon commented on a reader's comment in that issue: —*EFM*

> I just got round to reading my article in *IE* No. 27 and saw your note that another subscriber had suggested that the radioactivity in the welds was due to pre-existing radioactivity in the grinding wheel.
>
> I have checked the material in the angle grinder's disk and it is only slightly above background.
>
> In any case, I have owned this tool and its disks for several years, so any radioactivity in it would long since have returned to a constant level. The short-term changes which I am observing can only be due to some process that took place during the welding and afterwards.
>
> Thanks for another excellent issue.
>
> Cheers, George Sassoon



We are getting multiple samples from our cells that show a *positive* decay rate. The one I am showing you is doubling in radioactivity every 26-34 days, and has done so far about eight weeks. We are trying to locate other labs that have seen such a thing. We have found nothing like it in the literature or on the Internet. We believe this is evidence for the di-neutron, but we would like other labs to duplicate our experiments before we publish our findings. This stuff is weird! Any light you could shed upon this problem would be greatly appreciated.

[October 20, 1999] We would like to update you on what we are seeing. The graph we sent you is now flattening out. We expect it to start declining soon and take on the more conventional shape of a declining decay curve. We predict that it will look like a long flat bell curve with the right hand side greatly extended from the high point. We strongly believe this graph is created from the mixture of di-neutrons (which we cannot detect) and a beta emitter, in this case lead-210. The di-neutrons are remarkably stable particles that are being continually captured by the lead-208. The trick here is that the lead - 208 is capturing the di-neutrons and becoming lead-210 faster than the lead-210 is decaying back into lead-209 or lead-208. Thus, it looks like we have a positive half-life!

If any of your contributors would like to put forward an alternative theory, we would appreciate hearing from them. Our facilities at Bradley University do not have the means to detect di-neutrons. Therefore we can only guess at what is really going on and hope that a better equipped lab will be interested enough to develop some definitive theories and experiments.

Again, thank you for giving us an opportunity to make our work public.

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John P. Kenny, Ph.D., Bradley University, 309-677-3002

"Great spirits will always encounter the most opposition from mediocre minds." —Albert Einstein

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Vortex Filaments, Torsion Fields, and the Zero-Point Energy

Moray B. King (Copyright 1998)*

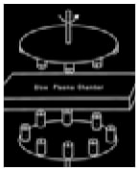
This introduction to Mr. King's ZPE article is really not so much an introduction as an appeal, and this particular spot in the magazine seemed the most logical place to put that appeal. Articles and discussions about the "zero-point energy" and the "zero-point field" are becoming ubiquitous. However, notice that within this article King lists seven "Paradigm Camps Regarding ZPE," and nine different "models of the vacuum." Most of these positions are antithetical to what is fast becoming the "conventional ZPE view." Here's the appeal—I want to see more papers submitted that follow those other views.

This should most certainly not be considered a swipe at the ZPE theorists. We are publishing King's piece here, and have published many articles about the ZPE in the past, and will continue to publish them in the future. But I, as a fluid ether proponent, recognize that there are plenty of other views out there that both 1) accept the possibility of O/U energy machines and 2) don't rely on the ZPE.

Indeed, a strong case can be made that the "ZPE" is not *an infinite plenum. [See for instance the paper by P. W. Milonni, "Casimir Forces Without the Vacuum Radiation Field,"* Phys. Rev. A, *March 1982.] Well then, if not the ZPE, what is the source of energy for those O/U machines we hear so much about?*

I want to see the debate. Having witnessed how badly electrodynamics has been handled for decades now, I'm not at all comfortable with the idea that somehow quantum mechanical derivations of the ZPE aren't also the product of a severe foundational misunderstanding. Let the O/U machines spark, rattle, and roll, but let's not all get fixated on one particular brand of theoretical explanation.—JDK

Abstract



An hypothesis is proposed that plasma vortex filaments induce corresponding torsion in the physical vacuum which coheres the zero-point energy. Large energetic effects are expected when the filament is closed into a vortex ring plasmoid (like ball lightning), which can be created by subjecting a glow plasma to an abrupt discharge, bucking electromagnetic (EM) fields, and counter-rotating EM fields.

Introduction

What is the nature of pure vacuum, the "fabric" of empty space? Historically scientists believed space was comprised of a material ether capable of supporting the propagation of light waves. Such a view led to immediate contradictions. It would have to be as stiff as a dense solid to manifest the high velocity of light, yet be tenuous enough to allow matter to travel through it unperturbed. Failure to detect an ether wind from the earth's relative motion convinced the scientific community to accept the theory of relativity. Here the appealing concept of Lorentz invariance, where all inertial observers (moving at constant velocity) would observe the same laws of physics (including a constant speed of light), yielded a seemingly elegant simplicity. The ether was an unnecessary artifact and could be assumed not to exist. Thus in the early 1900s the scientific community believed empty space to be a void, and today's textbooks typically support that view.

However, in the 1930s quantum mechanics became accepted because it so accurately described atomic phenomena. The equations of quantum mechanics include a term that describes an ever present, underlying energetic jitter to all phenomena whose source is from the fabric of space itself. The jitter is called "zero-point fluctuations" (ZPF) or "zero-point energy" (ZPE) since the fluctuations are not from thermal radiation, but are present even at absolute zero degrees Kelvin. Quantum electrodynamics (QED)[1] has the ZPE at its basis where the vacuum can manifest pairs of oppositely charged, virtual (short-lived) particles. The Heisenberg uncertainty principle is often invoked to allow "borrowing" The ZPE for short time periods in order to explain atomic events and particle interactions. This is a peculiar use of the uncertainty principle since it was originally intended as an inequality expression that limits the accuracy of a quantum measurement, yet in this case it is treated like an equality expression to limit how much energy can be borrowed for how long. Such an approach rationalizes a small "loop-hole" in the law of energy conservation, which is often cited as the actual reason why the vacuum energy cannot be tapped for large amounts of energy. However, if the ZPE truly physically exists then real energy is present, and its conservation is not the issue.

Zero-Point Energy Paradigm

At the heart of the issue is a paradigm conflict. Most scientists were taught that the vacuum is an empty void, yet quantum theory concludes it is an energetic plenum. It cannot be both ways. The conflict has given rise to many paradigm "camps," each with its own characteristic belief regarding the vacuum energy:

Paradigm Camps Regarding the ZPE:

1) Quantum physics is wrong. Quantum events can be explained classically using self-fields. The ZPE does not exist.
2) Relativity is wrong. A material-like ether exists.
3) Quantum physics is correct, but the ZPE is a theoretical artifact; it is not real.
4) The ZPE physically exists, but its magnitude is too small to be an appreciable energy source.
5) The ZPE physically manifests large energetic fluctuations, but they cannot be tapped because of entropy; they are random and ubiquitous like a uniform heat bath.
6) The ZPE is a manifestation of chaos in an open nonlinear system. Under certain conditions it can exhibit self-organization and therefore become available as a source.
7) The ZPE is a three-space manifestation of electric flux from a physically real, fourth dimension of space. It can be twisted into our three-space yielding alterations in the space-time metric. It can be tapped as a source, and doing so locally alters gravity, inertia, and the pace of time.

Western academia is dominated by beliefs 3), 4), and 5). Camps 1) and 2) try to model all physical phenomena purely at the classical level. Probably the toughest for them to explain is the EPR[2] non-local connection between two separate elementary particles (that originated from a common quantum event). Sophisticated ether models[3] are sometimes proposed, which ironically have similarities to belief 7) whenever the flexible space-time manifold is viewed akin to the ether. Russia has a large academic interest in beliefs 6) and 7). In addition, they have contributed abundantly to the literature involving both theoretical and experimental investigations of torsion fields, a helical spinning coherence in the fabric of space associated with all spinning bodies (including elementary particles). Recently translated articles[4,5,6] show that many ideas regarding the ZPE considered esoteric and speculative in the West have been taken seriously, theoretically developed, and experimentally investigated by Russian scientists.

There is another major paradigm division across the scientific community regarding hyperspace. Do more physical spatial dimensions exist than the commonly perceived three dimensions of space? (The time dimension does not qualify unless it is considered to be a true spatial dimension as well.) No doubt the majority

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believes not. Physicists often model higher dimensions mathematically, but typically do not believe they represent a real physical hyperspace. Some "compact" the higher dimensions topologically into microscopic tubes so as not to manifest them as spatial dimensions.[7] The philosophical bias is basically "If we can't perceive it, it can't exist." However, the scientific community has always had a minority camp that believes hyperspatial dimensions physically exist[8] and that it is human perception that limits us (like "flatlanders") from seeing them. The principle of Occam's razor (simplest theory explaining all) is often cited as the reason hyperspace should not exist. However, if the strange observations of quantum mechanics (*e.g.*, quantum logic, wave particle duality, non-local connectivity, etc.) as well as space-time curvature of general relativity are to be physically modeled, then utilizing a physical hyperspace might beget the simplest theory after all. Moreover, such modeling when applied to the ZPE could produce fruitful suggestions for experiments that might tap it for large output power.

Geometrodynamics

Perhaps the most powerful of the ZPE descriptions is Wheeler's geometrodynamics[9] where the (mass equivalent) energy density of a single vacuum fluctuation is on the order of 10^{95} g/cm^3. Wheeler derives this value by inserting the ZPE's spectral energy density expression from quantum mechanics into the stress-energy tensor of general relativity. The high frequency modes of the ZPE yield such a huge energy density that space-time warps (like a black hole) into microscopic hyperspatial filaments called "wormholes" that can channel electric flux between separate regions of 3-space or possibly to alternate parallel universes embedded in a "super space." The mouths of these wormholes are on the order of the Planck length, 10^{-33} cm (that is twenty orders of magnitude smaller than the electron). In 3-space they manifest like primitive charged particles or "mini holes" whose polarity is set by the direction of electric flux. The electric flux normally passes orthogonally through our 3-space from a fourth dimension with small residual (vectorial) components aligned in 3-space to manifest the ZPE jitter. Thus the flux appears to enter through "mini white holes" and exit through "mini black holes," and this action creates the foundational basis of charge pair production. The mini hole pairs are constantly being created and annihilated in a fluctuating state of chaotic turbulence called the "quantum foam." On a large scale the quantum foam averages to yield the familiar flat space-time metric, and it provides an ideal substrate to model QED's virtual charge activity. By combining quantum mechanics' ZPE spectrum and general relativity without any extra assumptions, Wheeler created an "already unified" field theory that ironically yields a specific model for the ether when viewed from a 3-space perspective: It appears like a turbulent plasma.

The wormhole model of charged particle pairs offers the prospect of geometric descriptions of the real elementary particles. Such modeling is intuitively appealing especially in view of a similar manifestation that can occur in hydrodynamics, the Falaco soliton.[10] The Falaco soliton is a vortex filament that can be created in a quiescent swimming pool. If a frisbee is stroked across the pool's surface, it will create two oppositely rotating, surface circulations in its wake, which can persist for minutes. An arcing, underwater, thin vortex filament connects the two circulations. If ink drops are poured into one vortex, the ink will flow helically along the arc toward its paired counterpart and highlight the connecting thread vortex filament. If the filament is cut, the Falaco soliton will instantly disappear with an audible pop. In an analogous view, wormhole filaments may provide a way to model nonlocal EPR connectivity where oppositely moving particles born from a quantum pair production event are still connected through the higher spatial dimensions. The vortex filament is an archetype that appears at all levels of nature. It not only plays a role in modeling torsion fields and elementary particles, but it also might well provide the key for abundantly tapping the zero-point energy.

The goal of geometrodynamics is to ultimately model the real elementary particles. Since the ZPE flux flows orthogonally to 3-space, some type of vortex action in this flux, perhaps manifesting as a toroidal vortex ring, is required for the particle's persistence in 3-space. The ZPE flux continuously feeds the vortex in order to maintain it, much as the flow of a river maintains a whirlpool. Geometrodynamics was successful in modeling spin-1 bosons as three-dimensional topological entities called "3-geons," but was unable to model the spin $^1/_2$ fermions in a like manner.[11] The problem with spin $^1/_2$ particles is that their isotopic spin description exhibits a quantum two valueness that cannot be modeled geometrically in 3-space. After one 360° rotation the fermion does not return to its original state, but instead it alternates between an "up" and "down" state, requiring two full rotations to return to the original state. Thus the electron cannot be modeled as a three-dimensional geometric entity. Geometric modeling will require invoking higher dimensions where the electron's space-time manifold becomes "disconnected" from 3-space to allow a fourth-dimensional rotation, yet it asymptotically appears to connect to the global space-time metric.[12] From a 3-space perspective the electron would be classed as a "non-orientable" topological entity, like a Klien bottle. (The mouth of a four-dimensional Klien bottle appears as a toroid when intersecting 3-space.[6,13] Thus could the Dirac virtual fermion vacuum appear as a sea of toroidal forms?[14]) Hadley[15] has recently proposed a "4-geon" model for the electron using only general relativity, and was able to show that his model yields the strange, non-distributive, quantum logic where the quantum particle seems to somehow nonlocally "sense" its experimental environment to manifest the appropriate conjugate state. The model utilizes a peculiar solution of general relativity called "closed time-like curves" (CTC). The solution involves hyperspatial wormholes (filaments) that can allow self-interaction across the time dimension. This presets the stage for a probabilistic outcome consistent with the environment, even for the "delayed choice" experiments.[16] It is surprising that the strange behavior typical of quantum mechanics can be derived from the classical-like equations of general relativity. The behavior essentially arose from topological vortex filaments spanning across the time dimension.

Plasma Vortex Filaments

Vortex filaments naturally arise in turbulent plasmas. Bostick[17] shows that filaments tend to form in counter-rotating pairs. The vortex filament exhibits a force-free, natural flow where the electric (E field) vector and magnetic (B field) vector can both be aligned with the particle velocity vector in an ever-tightening spiral. Moreover, such spiral field behavior can also occur in pure vacuum as well. Kiehn[18] shows that dynamic structures with non-transverse E and B fields can occur in vacuum as solutions to Maxwell's equations. They exhibit topological torsion and have spin qualities like the photon. Rodrigues[19] has also derived non-dispersive, solitary wave solutions to Maxwell's equations that can even manifest speeds exceeding light. The Russian literature on torsion fields also describe solutions along the torsion filaments exceeding light speed.[4] (Since light is typically used to "define" the 3-space portion of the metric, such faster-than-light solutions would seem to propagate on filaments in the hyperspace.) There appears to be an archetypal pattern here:[20] just as turbulent plasmas exhibit a tendency to form into force-free vortex filaments, the virtual plasma comprising the quantum foam can exhibit a like tendency. This suggests a hypothesis: a highly energetic plasma filament induces a corresponding vacuum torsion filament. The coherent tandem of vortex filaments couples to the orthogonal ZPE flux and twists more of it into our 3-space. Since the force-free vortex filament exhibits self-tightening tendency,[21,22] a plasma filament which

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closes onto itself (forming a helical vortex ring plasmoid[23,24,25]) would experience a positive feedback loop of increasing energy density[26] which ultimately would bring the ZPE effects into play. Once the quantum foam's virtual plasma couples to the vortex ring, the feeding ZPE flux would manifest a "nonorientable" entity akin to a "macroscopic charge." This might be the energy source feeding ball lightning as well as Shoulders' "electrum validum" (EV).[27] Such vortex phenomena also arises from a plasma's anomalous glow discharge as evidenced by the experiments of Correa,[28] who appears to have rediscovered the operating principle of the plasma tubes of Moray.[29] Thus the vortex filament manifests in both the virtual plasma of the quantum foam to produce the elementary particles as well as in turbulent plasmas to produce plasmoids, ball lightning, and EV's. It appears to be an engineering key for tapping the vacuum energy.

The vortex filament is at the heart of modeling torsion fields where filaments can intertwine and potentially grow as large braids.[30] Shpilman[31] uses this theme to describe the electron as possessing a plethora of vortex filaments flowing from the charge and interacting with its environment. Such a model could likewise be applied to ball lightning or the EV where a dynamic polarization interaction with the dielectric environment[32] seems necessary for its stability. In a description like Shpilman's, an EV sprouts vortex filaments whose negative end is braided around the EV's internal toroid and whose positive end strikes the dielectric substrate, sucking electrons from before it while depositing them in its wake as it travels. Rather than exist as a collection of electrons, the EV could be thought of as a braided cluster of vortex filaments which manifests as a kind of "macroscopic charge." Torsion filaments can be thought of as braids starting with microscopic wormhole filaments and recursively building up in the physical vacuum, even to a macroscopic level.

Models of the Vacuum

The existence of braided torsion filaments in the vacuum requires a rather exotic model for the physical vacuum. The literature contains a variety of proposals for modeling the physical vacuum. Some would support the potential existence of a rich set of organized, "subtle" structures, while others would rule them out. In the next century as experimental evidence accumulates, it would not be surprising to see the scientific community divide into paradigm camps regarding how to best model the physical vacuum:

Models of the Physical Vacuum

1) Void
2) Fluid ether
3) Spectral fluctuations
4) Orthogonal electric flux
5) Turbulent plasma
6) Virtual elementary particles
7) Toroids
8) Feynman lattice
9) Phyton lattice

The void model would have to explain action at a distance while a fluid ether would have to explain the observations of physics in a local mechanical way. The zero-point energy density spectrum is popular in the field of stochastic electrodynamics[33] where quantum effects are explained classically by matter's interaction with the all pervading zero-point energy density spectrum. EPR non-local connectivity remains unexplained however. Wheeler's geometrodynamics is essentially the orthogonal flux model which manifests a turbulent plasma model in 3-space. Dirac's virtual particle sea[34] was perhaps the first proposal for modern QED with the toroidal vacuum[14] as an attempt to avoid using point particles. The Feynman lattice[35] is a model that tries to explain the manifestations of the wide variety of elementary particles. The phyton lattice features spin and torsion. Since the hypothesis is that vortex filamentation can induce a large ZPE interaction, the phyton lattice model might inspire some effective experimental suggestions.

Akimov[4] is a leading researcher who has proposed the phyton lattice model for the physical vacuum, and this model is popular in Russia. Akimov hypothesizes that the basis of the vacuum is a quasi-particle called the "phyton" which is sized at the Planck length and exhibits two counter-rotating spins as if it were a pair of particles superimposed one within the other. Obviously for this to be physically modeled, space must contain a higher dimensionality. Thus even though not stated explicitly, Akimov's model is fundamentally hyperspatial in its nature. Phytons proliferate all of space and, for simplicity, can be thought of as forming a lattice when in the vicinity of matter. The phyton can polarize in various ways to manifest the fields of nature. It can separate into opposite charges to manifest the electric field and support QED vacuum polarization. The gravitational field is modeled by the phyton separating longitudinally (where the spin axes still remain opposite) in an oscillatory fashion and is called "longitudinal spin polarization." In response to a spinning body, one of the phyton spin axes can flip so that both become aligned, resulting in what is called a "spin transverse polarization." Such a polarization is used to model torsion fields and torsion propagation. Akimov's diagrams illustrate how the phyton lattice polarizes in response to a spinning body (including the elementary particles). If the body's spin axis points up, the phytons above the body point up; those below point down. Why that particular polarization? Further discussion is required since that selection relates spin to the higher geometric construct of torsion and chirality. A right-hand rule was used to define the spin axis; a left-hand rule could have been chosen just as well. By picking this particular spin transverse polarization, Akimov is selecting a preferred chirality for the fabric of space. Chirality refers to spin becoming associated with a helix having either right-handed threads or left-handed threads. Is there a preferred chirality to the fabric of space? Kiehn[36] has described how a chiral vacuum could be topologically modeled in a curved space-time manifold. It would yield subtle electromagnetic and torsional effects. Could this be the basis for preferred molecular chirality observed in living systems? The question is not yet answered, but in Russia there is biological research interest and active experiments exploring the interaction of torsion fields with living systems and possible medical applications.[5] The activation of powerful torsion fields via plasma filaments might produce dramatic effects in the biological arena. Years of Russian research has garnered experimental support for Akimov's model despite the many still outstanding, theoretical questions. Our understanding of vacuum physics is still at an early enough stage that the science must be explored empirically. Perhaps the most valuable contribution would be an experiment that produces such a large energetic effect that a free running energy machine would be trivial to construct.

Plasma Stimulation

The primary hypothesis for tapping the ZPE is that stimulating a plasma into a self-organized coherent form induces a like coherence in the virtual plasma of the quantum foam. This would suggest that a glow plasma be subjected to one or more of the following stimulations to induce a coherent nonlinear self-organization:

1) Abrupt EM pulse
2) Bucking EM fields
3) Counter-rotating EM fields

There are "free energy" inventions associated with each stimulation. For example, Shoulders,[27] Correa,[28] Moray,[29] Papp,[37] and Graneau[38] all utilize the abrupt discharge in their inventions to manifest a plasmoid form as well as excess energy.[39] Correa, Moray, and Papp apply the discharge directly to a glow plasma. Shoulders pulses a liquid metal electrode, and Graneau pulses a small cylinder of water. Shoulders, Correa, and Graneau have observed plasmoid formations via photographic methods. Shoulders, Correa,

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and Moray tapped the excess energy via rectifying an output pulse, while Papp and Graneau have focused on tapping the anomalously large mechanical reaction force via a piston. It is noteworthy that an abrupt discharge in a glow plasma or liquid also produces a characteristic bucking field compression. Mesyats[40] has described in detail the behavior of a liquid surface in response to an electric discharge. It forms a stalk protruding from the surface, which is symmetrically surrounded by a polarized glow plasma. The tip of the stalk explodes into the glow plasma yielding a perfectly symmetrical compression by two ion layers. It is the symmetry that guides the emitted electron plasma to form into a closed helical toroidal filament, producing the EV or plasmoid.[39]

A number of inventors have used radioactive materials to help create the glow plasma. Moray[29] is perhaps the most famous; his "Swedish stone" cathode contained a mixture of luminescent and radioactive compounds pressed into a germanium pellet to make a "radioactive transistor" with sufficient gain to drive a small loud speaker. Papp[37] also used radium and luminescent materials in his electrodes to help ionize his inert gas mixture. Brown[41] used this principle in a simplified fashion to make his nuclear battery, where a weak radioactive source creates a glow plasma which interacts resonantly with an LC circuit to produce anomalously excessive energy output. The simplicity of Brown's invention makes it a good candidate for replication.

The use of bucking EM fields to produce a scalar excitation in the vacuum energy has been emphasized by Bearden.[42] Abruptly opposing EM fields produce a stress on the fabric of space and increase the electric potential, yet since the fields are in opposition, they sum into a net zero field vector. Nonetheless, the abrupt stress and release can cause an orthorotation of the ZPE flux,[43] and can couple vacuum energy into the glow plasma being so stimulated. Caduceus coils[44] or Mobius coils[45] have been suggested for such excitation. Recent Russian experiments[6] with Mobius coils have claimed to launch "non-orientable entities" akin to ball lightning, as well as produce negative energy formations described as "magnetic monopoles." Subjecting a glow plasma to abruptly bucking magnetic fields might produce some large ZPE effects.

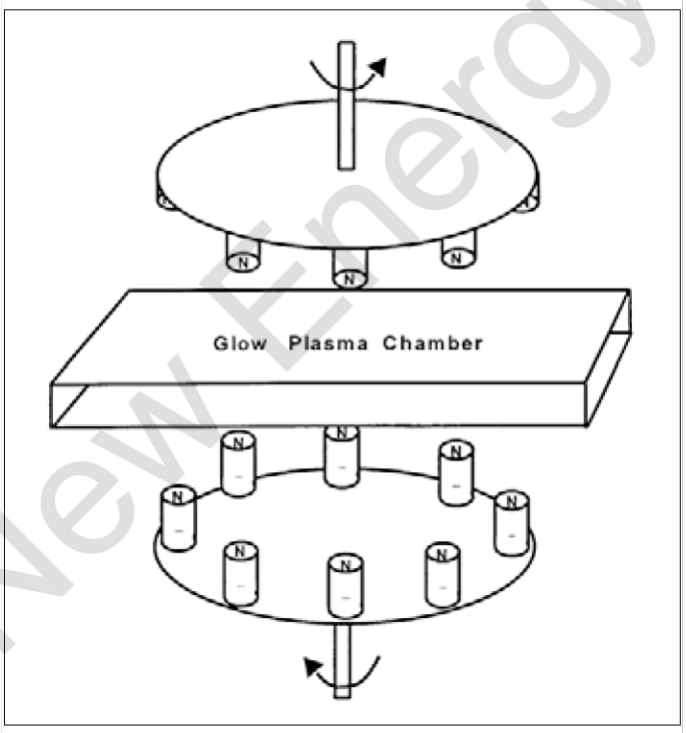

Figure 1. Stimulate a glow plasma with counter-rotating, bucking magnetic fields as well as an abrupt electric discharge from a pulsing circuit (not shown).

Bedini[46] used the bucking field principle in his "modified Kromrey, G-field" generator from which experimenters[47] claimed to have observed an output of "cold current," *i.e.* the ability to conduct appreciable power along thin wires without heating them. Bedini's generator consisted of two steel core coils that are spun through the two air gaps of two aligned horseshoe magnets. Bedini's plans show ordinary coil windings, but he mentioned using "proprietary windings" as well. Were the windings caduceus, bifilar, or perhaps both? The windings appear balanced and slip rings are used to extract the output, which should be combined in parallel such that current would not flow from one coil directly to the other (because of perfect phase opposition). The simplicity of Bedini's invention make it an attractive project for the hobbyist.

Akimov's phyton model motivates using a counter-rotation stimulus. If a glow plasma is stimulated with two charged, counter-rotating disks, it may activate a significant ZPE coupling. It seems this approach was used for the Swiss ML converter.[48,49] Further excitation could be provided by using the bucking field motif. If magnets are mounted on the surface of each counter-rotating disk aligned for repulsion (Figure 1), the glow plasma would be excited by both counter rotation and magnetic field opposition. Gray's motor[50] utilized pulsed opposing magnetic fields along with sparking discharges across the rotor-stator gap. Sweet[51] may have excited a fractoemission plasma by a counter-rotating, pivoting grain motion within his conditioned barium ferrite,[52] thus providing stimulation by both techniques. Perhaps an invention that subjects a glow plasma to all three stimulations might produce the largest effects of all.

Summary

Nature appears to operate recursively through levels of self-organization to produce what seems to be an archetypal "quantization" pattern: A plethora of "particles" combine to manifest as a flux or continuous flow at a macroscopic level relative to the size of the individual particle. Nonlinear behavior in the flow can then produce "topological defects" (*i.e.* solitons, vortices, discontinuities, filaments, vortex rings, etc.), which then can be viewed as if they were "quantized particles" at a new macroscopic level. If similarly gathered as a plethora, they would form the basis for the next higher level flux or continuous flow, which could then repeat the pattern. Turbulent plasmas exhibit the behavior when they form plasmoids. Geometrodynamics proposes analogous behavior to form pairs of charged elementary particles from the quantum foam. Kiehn[53] shows that Cartan's topological methods can abstractly model the archetypal process of evolution of continuous flux to quantized "defects," regardless of the dimensionality. Thus, in principle Cartan's methods can apply to hyperspatial models of the ZPE and could someday yield a practical engineering theory for the vacuum energy. When the concept is applied to the substantive models of the physical vacuum, torsion fields become described. Descriptions of wormholes, strings, braids, fiber bundles, vortex rings, etc. appear in the literature, and in a sense could be modeled from a topological foundation of the vortex filament. A primary hypothesis is proposed that triggering a vortical self-organization in a plasma could exhibit a torsional coherence in the zero-point energy especially at the large energy densities that occur as the vortex tightens. The ZPE coupling is maximized when the vortex filament closes into a vortex ring, and the experimental production of excessive energy from ball lightning and EV's may be the evidence. The largest effects might be produced by subjecting a glow plasma to an abrupt discharge combined with a counter-rotating, bucking electromagnetic field stimulation. If such experiments indeed produce large energetic effects, then it would be easy for the scientific community to replicate a self-running device that directly taps the zero-point energy.

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Acknowledgments

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About the Author

Moray B. King has a B.S. in Electrical Engineering and a M.S. in Systems Engineering from the University of Pennsylvania.

His primary research interest involves exploring how the zero-point energy may become the basis for a new technology. Since 1975 he has given numerous conference presentations on this topic and has authored many published technical papers as well as the book, *Tapping the Zero-Point Energy*. In his career he has participated in a wide variety of engineering projects, often in the role of lead software engineer.
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"Man will occasionally stumble over the truth, but most of the time he will pick himself up and continue on."

Submitted by Walter S. Rosenthal

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INE—From page 27

combustion exhaust is capable of sustaining life." The press release also states: "All gasoline or diesel engines can be easily retrofitted to operate on MagneGas, and are expected to last longer because MagneGas has over 160 octane (implying smoother engine operation) and dramatically cooler exhaust. MagneGas is also safer by comparison to gasoline because, in the eventuality of a truly catastrophic accident capable of fracturing the heavy gauge storage tank, the gas dissipates instantly and, if ignited, burns without exploding." TTL claims that a 100 HP automobile traveling 50 mph would require a consumption of only 600 cubic feet of MagneGas per hour. TTL states that that amount of gas could be produced for only $.08—the approximate cost of a kilowatt-hour of electricity. Very remarkable, if ultimately verified in practice.

The "over-unity" claims for the gas are of interest since similar claims for CarboHydrogen™ gas (of DW Energy Research, LLC) have previously been made, though backed up by detailed experimental data and description of experiments published in *Infinite Energy*. Curiously, no mention of these previously published over-unity results and experiments for CarboHydrogen gas appear in any of the literature on MagneGas that this reviewer has seen. Also, no *control* experiments have been referred to in TTL or Santilli materials. It would obviously be of great interest to know whether the process "over-unity" has been seen to occur in identical liquids that have not been treated by the magnetic process before electric arcing—otherwise how are we to judge the effect of the magnetic treatment? Perhaps Dr. Santilli or TTL will be publishing such comparisons in the future.

TTL states that 3,412 BTU equivalent of input electricity leads to the production of MagneGas "containing 7,144 BTU" plus 2,318 BTU heat. This gives the 2.78 over-unity. However, no mention is made of the combustion energy value of carbon input in the liquid that augments the input electricity. True enough, the carbon may come from an exceedingly cheap resource, such as sewage, but the carbon input must be considered in any evaluation of the claimed scientific over-unity condition.

In 1998, Dr. Santilli presented very interesting and pioneering theories about and experimental data on "magnecules" in an article published in his *Hadronic Journal*, Volume 21, pp. 789-894. In that article he claims to show that atoms and molecules in gases, liquids, and solids can be bonded by a new force—magnetic bonds. He writes, "The origin of the new species rest in the magnetic moment of electrons in their orbits around nuclei, which has been ignored throughout this century due to their special distribution." The *Journal of New Energy*, Volume 4, No. 1, 1999 devotes all of its 314 pages to articles by Dr. Santilli under the rubric, "The Physics of New Clean Energies and Fuels According to Hadronic Mechanics." Some of this material has previously been published by Dr. Santilli in past issues of *Infinite Energy*, before his series of articles were terminated by him for reasons elaborated in *Infinite Energy* No. 27, pp. 75-76.

The impossible often has not been tried.

Submitted by Walter S. Rosenthal

Piece of History—From page 55

dirigibles will be more deeply concerned with construction for purposes of sport, the flying machine of all types as a factor in transportation and for use in war will not be neglected. The makers of automobiles have only recently awakened to a realization of the fact that their biggest field for future business lies in the exploitation of the commercial vehicle. Aeroplane manufacturers may profit by the short-sightedness of their brethren in the motor world to the extent of booming aeronautics both as a thrilling sport and as a highly important commercial possibility.

"Advocates of 'exclusive aeronautics' should learn this lesson. Aeronautics is a science, an industry, and a future factor in war and business, as well as a sport."

Another side of the subject which must not be neglected is the financial side. The money which is being earned by aviators is, in many instances, going back into the industry to help make possible greater advances in the science of air navigation.

Gentleman, let us not knock "commercialism." Let us, instead, boost it for what it has already done for aeronautics, and, still more, for what it is capable of doing in the future. Far from being a hindrance to aeronautics, it is a decided help. A hearty toast to "Commercialism."

If you have an interesting short historical article for "A Piece of History" please send a copy with complete reference information to: Barbara DelloRusso, Managing Editor, *Infinite Energy*, P.O. Box 2816, Concord, NH 03302-2816.

We'd like to focus on controversial science and technology opinions of the past which have since proven to be an important innovation for the present and future.

Cook—From page 62

In March 1997, the same model that had been set up at Hughes (which at first showed positive results but was later "readjusted" into a "fantasy" that didn't work) was honestly tested at a computer simulation testing facility—Knowledge Revolution of San Mateo, California. The computer information needed to set up the model was provided by Richard Rose, a Designated Engineering Representative (DER) for the FAA with degrees in both aeronautical and civil engineering. His specialty is structural and stress engineering. Taking into consideration "the human factor," no clue was provided to the programmers as to what the system to be modeled in the computer was supposed to accomplish, because if they knew what it was all about, they wouldn't believe the positive results and might do what was wrongly done to the 1990 Hughes computer model test. Cook did not like to do this, but human nature had to be taken into account.

Dr. Paul E. Mitiguy conducted the true and honest computer testing at Knowledge Revolution, and he found a very interesting impulse generated by the system. Although he didn't know it, this was the impossible, unidirectional, internal, reactionless force deemed impossible by Newton's laws—the very one first detected by the Hughes computer in 1990 but later altered by the Hughes programmer into a physical monstrosity that didn't work. It is certainly hoped that Dr. Mitiguy doesn't get too upset when he finds out what Cook and Rose withheld from him. He did a terrific job.

So far seven top engineers from the Jet Propulsion Lab, Boeing Aircraft, Hughes Aircraft, General Electric, Rocketdyne, United Airlines test center, and the FAA have seen and tested Cook's working models. They have all endorsed the CIP principle as being sound and a practical propulsion system. ❑❑❑

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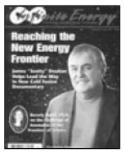

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